BIOMED
WU
26
A819c
1921

D
000 132 650
3
UC SOUTHERN REGIONAL LIBRARY FACILITY

A CENTURY OF DENTAL ART

THE LIBRARY
OF
THE UNIVERSITY
OF CALIFORNIA
LOS ANGELES

A CENTENARY MEMOIR

1820

|

1921

CLAUDIUS ASH, SONS & CO., LTD.

LONDON:
PRINTED BY WILLIAM CLOWES AND SONS, LIMITED.

Biomed
WU
26
A819c
1921

MEMOIR.

Paper I.

HISTORICAL CLAUDIUS ASH AND EARLY DEVELOPMENTS OF THE DENTAL ART.

IT is always interesting to trace the history of an important industry connected with a great profession, and, in reviewing the early development of the subject of our article, we find that it was intimately bound up with the profession which it served.

Four hundred years ago Ambrose Paré, the great French surgeon, thought he had reached the limit, and confidently declared that after the publication of his great work there was nothing left for posterity to add. But the experience of centuries of effort has shown mankind that there is no boundary to invention and progress, although the advance may be made by steps infinitesimally short and painfully slow. Sometimes there is a rush, as in the nineteenth and present centuries; sometimes, as in the Middle Ages, there has been stagnation; but, on the whole, science, and with it dental science, progresses.

Natural Teeth Mounted upon Carved Ivory Denture.

At the beginning of the nineteenth century we find, in regard to artificial teeth, that most practitioners used natural ones, but some few

dentists were, and had been for some years, making in their own workshops crude specimens of mineral teeth, commonly called "terro-metallic teeth." Every man had his secret and kept it close.

While natural teeth were employed for dentures, middlemen collected them from the battlefields and from hospitals. Most of them, however, were collected by the grave-diggers, who, after their week's work in the burial grounds, came to individual dentists all over the country on Monday mornings with sacks containing the gruesome skulls and jaws which they had taken from the newly-filled graves. These natural teeth were mounted upon carved dentures of walrus or hippopotamus ivory or on gold.

Charley Upton, a man skilled in metals and early porcelain teeth-making, was employed in his youth at a dental depôt in the early thirties of last century. It was his humble task to remove the natural teeth from the jaws as they were received from the body-snatchers, and to string them carefully together in sets, after disinfection, if that were possible, for future sale. Upton, who passed away some few years ago, often said what a blessing it was when Claudius Ash brought out his gold tube teeth, and he had no longer to handle the unsavoury jaws and to prepare the human teeth for the dental market.

By the time we reach 1841 we find Sir Edwin Saunders, Court Dentist to Queen Victoria, saying: "First in point of excellence, Ash of London, whose untiring skill in facilitating the labours of the dentist and preparing the various materials he requires may well entitle him to his gratitude and support. This gentleman, after a most extensive and elaborate series of experiments, has succeeded in placing in the hands of the dentist a material which, with skill and care on the part of the latter equal to that employed in its preparation, must leave little to be desired."

In the Post Office Annual Directory for 1814 the reader will find the simple entry "Ash & Sons, Silversmiths, 64, St. James Street, London." From this address the business was later transferred to 9, Broad Street, Golden Square, W. The senior member of that firm was Claudius Ash. He was a man of delicate constitution, of modest demeanour and a kindly disposition, firm but just, an old-time, highly-skilled master-craftsman and a good business man. With him worked his four sons, George, Edward, William, and Henry, with five or six assistants and one small boy.

For some years at Broad Street Claudius Ash continued to make jewellery of beautiful design, especially ornaments of fine gold-wire filigree work, which was then the fashion. At that time the workman was not considered a finished artist, after his seven years' apprenticeship, until he had produced

some striking piece of artistry, which, by the gracious custom of the period, he gave to the most beloved of womankind—his mother. To Claudius Ash his apprentices were his children, and had to work like his own children. Of two of his apprentices, one became manager of Ash's great Teeth and Rubber Factory at Angler's Lane, Kentish Town, and the other rose to be the head of the Precious Metal Department, both living to a hale old age, and both in skill and character bearing witness to the fatherly training their affectionate old teacher had given them.

Often the master, Claudius Ash, took this artistic work to his customers

Claudius Ash at the Age of Twenty-one.

personally, and once, when calling on a dentist with a suite of finely-wrought jewels, the latter Mr. Thomson, of George Street, Hanover Square showed him a set of teeth mounted on 18-ct. gold, with gold springs and swivels, which he was going to put in the mouth of a patient. Holding it up to Claudius Ash, Mr. Thomson asked: "Mr. Ash, do you think you could do this kind of work?" He replied, he thought he could. So Mr. Thomson sent models and the necessary instructions for Claudius Ash to make a set of teeth. The order was executed in such an excellent manner that Mr. Thomson was pleased to show it to other dentists. They asked Claudius Ash to do their mechanical work, and thus a new business was started— that of working for the dental profession.

In performing this new kind of work, in which his intimate knowledge in the manipulation of silver, gold, and platinum stood him in good stead, his sensitive nature was constantly confronted with the unholy traffic and use of human teeth, and he was often heard to lament that a better tooth was not to be had than the French china tooth, nicknamed "French beans," which reached this country in large quantities. Their disadvantages were that they were not easy to work, were brittle, rather heavy and ill-coloured, and at the best were poor imitations of Nature. Mr. Ash began experimenting with every kind of rock and mineral he could think of as likely to lead to the manufacture of a serviceable porcelain tooth. His experiments were indefatigable, and although, as a careful economist, he had ample means, there was a period when he was compelled to pawn his silver plate in order to continue his researches.

This was hard and unlooked for after some years of experiment, but although he did not find for the moment what he was seeking, he gained much knowledge of the ceramic art. Concurrently with these experiments went the development of a dental supply house. Step by step, springs and swivels, gold plate and wires, gold solders, and many other things were made and sold, and practitioners helped him with their experience because they found that his expert acquaintance with metals, now diverted from ornamental to industrial purposes, was lightening their labours, and that he was better able to supply a uniform quality than they could produce for themselves. In addition to this, his word was his bond, so that he had the personal confidence, friendship, and support of contemporary dentists. Thus it happened that one of his friends, Mr. Joseph Corbett, of Cork, who held French dental qualifications, and was acquainted with M. Audibran, who himself had improved on the original French tooth, united with the subject of our memoir, and together they produced the "gold tube tooth."

Mr. Daniel Corbett, M.R.C.S., L.D.S., in his address as President of the British Dental Association in 1888, gives us a glimpse of his personal recollection of those stirring times in dental annals. "Six weeks," he says, "was the usual time spent in the manufacture of a complete denture when working bone and natural teeth. . . .

"In 1829 my father went to Paris to learn the process of manufacture

of the 'terro-metallic' teeth as invented by M. Audibran . . . On his return we laboured for some years at the manufacture of the flat teeth, with the usual uncertainty, meeting disappointments when least expected, but satisfactory results at times encouraged us to persevere further in our efforts to produce a perfect article.

"In the year 1832 a Mr. Hallit called upon my father for the purpose of introducing a new form of mineral tooth, solid, of the natural shape, and having a tube in it to carry a pivot in lieu of the soldering platina points which characterised the French pattern tooth. These teeth, after some disappointments, Mr. Corbett finally succeeded in making. Gentlemen, you see in our museum those beautiful specimens of mineral teeth manufactured by Messrs. Ash and Sons; they are the outcome of information given to that firm by my brother in 1837."

Tube teeth caused a beneficial revolution in prosthetic dentistry, and Claudius Ash studied means of producing them in quantity. With the knowledge he had obtained of feldspar, rock crystal, and the other ingredients, in his experimental years, it was simple for him to make a perfect mineral composition. After calcination the minerals were crushed into small pieces, ground dry, and finally pestled in a mortar under water until they were absolutely gritless, like the finest white cream; this was then dried and stored in sealed stone jars until required for use. The colouring materials were few then, but had to undergo the same careful process, and absolute cleanliness was, and is to-day, a *sine quâ non* for both, if the resultant teeth are to be perfect.

All this labour was done by hand, and it was very heavy work. The moulds were made of lead by the early tooth makers; but Claudius Ash's were a great improvement, which can easily be proved by looking at the shape and perfect finish of the gold tube teeth which are still in existence. Old customers have often since remarked that, although the colours were not of great variety, they were exceedingly natural.

The invention and introduction of this new tooth caused a demand which the maker in the beginning could scarcely keep pace with. Mr. Ash turned to one of his apprentices one day and said: "Edward, if I could only get up a stock of twenty thousand gold tube teeth, what a great thing it would be!" Before the War one of Ash's travellers disposed of close upon

two million teeth in a single short voyage. He telegraphed, "Sold out," and there were no aeroplanes then to bring a fresh stock.

Before passing from our immediate subject Claudius Ash and the early days of tooth manufacture — it must be remembered and emphasised how great a part France has played in the history of dental science, for to that great country belongs the honour of first producing porcelain teeth. In 1774 a French apothecary named Duchâteau conceived the idea of teeth made from mineral, and, applying to a French porcelain manufacturer, he, with the help of Dubois de Chémant, an enterprising and skilful dentist, made some dentures in one piece, which, however, turned out a failure. Despite this non-success, Duchâteau in 1776 was accorded the thanks of the French Academy of Surgery for his efforts.

De Chémant, with great perseverance, made further experiments, but was unable to obtain a substance the colour of which would resist the acids of the mouth. Through M. Darcet, the Assayer of the French Mint, he gained entrance to the Sèvres porcelain factory, where a little furnace was built for him. There he received the advice of expert ceramists, and finally achieved a success which has made his name famous as the dentist who first made and inserted porcelain teeth in the human mouth, although the particular form of his invention did not stand the test of time.

Some of his French dental colleagues, with what Herbert Spencer called "the bias of anti-patriotism," fearing that a portion of their practice would go to the inventor of the new teeth, united with Duchâteau—who in the meantime had quarrelled with de Chémant—and brought a law-suit against him, contesting his claim to the discovery, and stating that Duchâteau was the inventor. Their allegations were not proven, and they lost their case. His opponents perpetrated other annoyances against him, even destroying his furnace at the Sèvres factory, which proves the danger of being ahead of one's contemporaries. Darcet built him a new one, which de Chémant erected in his own house; but his life being embittered by this ceaseless strife, he shook the dust of France off his feet and made his home in England, almost within a stone's throw of the present site of Claudius Ash, Sons & Co.'s premises, viz., in Frith Street, Soho, London.

The story which we have met in several histories of dentistry, that de Chémant sold his secret to Claudius Ash, is a myth. It is true, however, as C. F. Delabarre declared in 1820: "M. de Chémant's method of making mineral teeth is that which has given birth to all others."

E. D.

A CENTURY OF DENTAL ART

1820—1921.

Part II.

DEVELOPMENT.

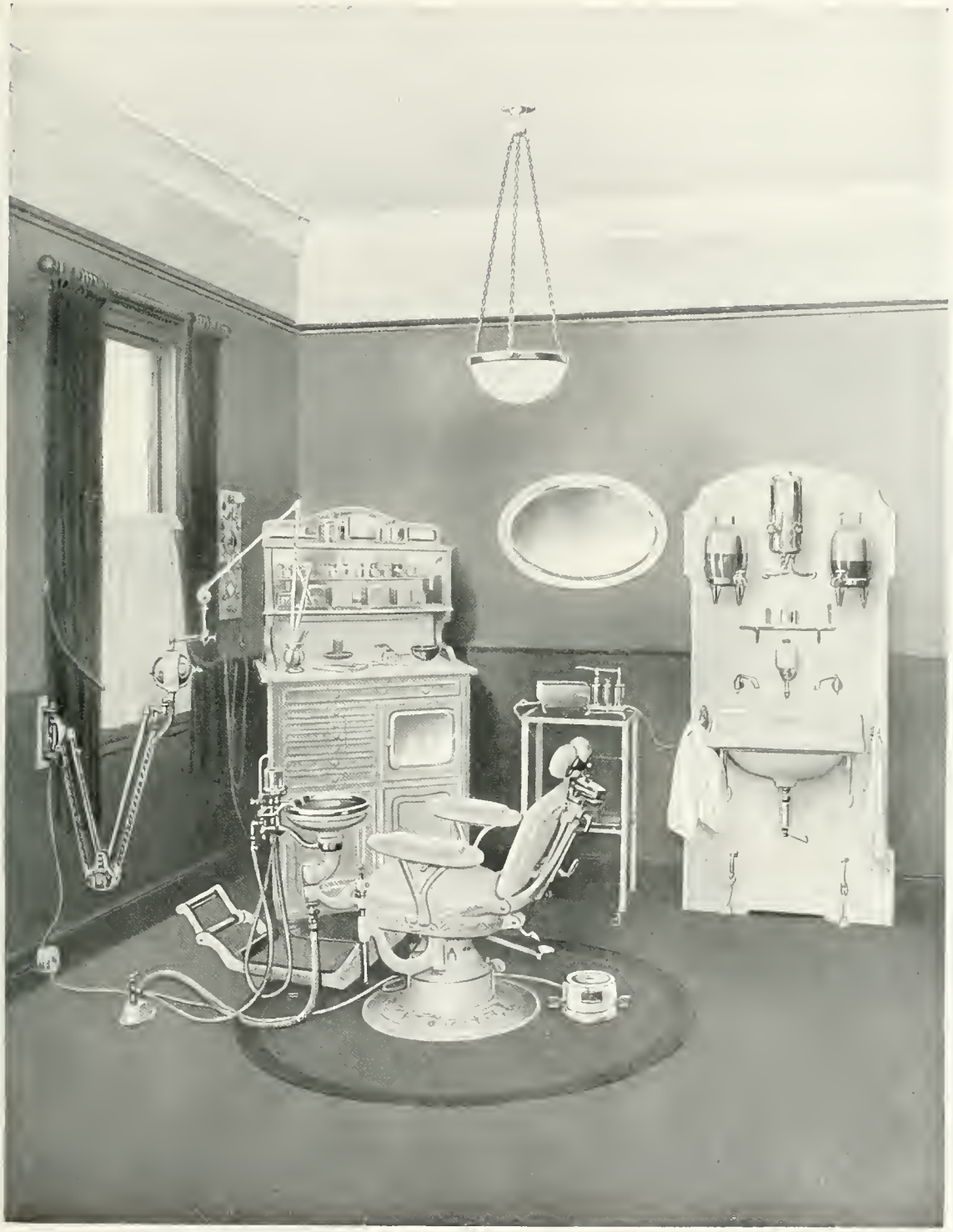
THE preceding paper dealt principally with the early history of artificial teeth, and brought us from the days of the efforts of individual dentists up to the introduction of tube teeth, in the 'thirties of the nineteenth century. We will now endeavour to review developments from the 'forties onwards until we reach the present day.

Such a review, to be a complete history, would require several volumes, because few industries embrace as many varied branches as does the dental. It demands the services of chemistry, metallurgy, hydraulics and electricity: the use of the most varied materials, from feldspar to beeswax, from rubber, gold, diamond-dust and oils to the rare woods used in cabinet work; and processes as fascinating as the firing of enamels in the cleanly neatness of an electric furnace, or the casting of molten gold by pressure ingeniously produced.

The joy of the craftsman is in a special degree open, not only to the practitioners of dentistry, but also to those who are engaged in the production of all that is essential to that profession, and with such a rich choice of subjects the writer finds it a difficult task to confine himself to the limits imposed upon him in this little Memoir, and at the same time to do justice to so wide and interesting a subject.

Take, to begin with, a metal which has played, and still plays, a great part in history. Platinum, formerly called "white gold," was discovered in the province of Choco, in South America, in 1736, and since then has been found in other parts of the world, but nowhere to such an extent as in the Ural Mountains of Russia. Its great resistance to heat (melting-point, about 3182 Fahr., 1750 Cent.) made it eminently suitable for use in mineral or porcelain teeth, and as it is malleable and unaffected by the fluids of the mouth, it formed the base of many a denture of continuous-gum work so long as it could be obtained at a reasonable price. In 1851 dentists could buy platinum at 26*s.* 6*d.* per ounce;

THEN



NOW

then, owing to the great demand for it for electricity and photography, it rose far above the price of pure gold. To-day platinum is, unfortunately, almost unobtainable. At the time when the twelve-rouble piece was in circulation in Russia, it had a face value of 24s., and as the coin weighed about 2½ oz. it was, at the outbreak of the Great War, worth about £24.

An interesting extension in the use of platinum was brought about by the production of a metal known as "dental alloy." Such a term might have meant any alloy suitable for dental work, but it did, in fact, mean an alloy of silver and platinum which, after being thoroughly combined in a molten state, was rolled into plate or drawn into wire, and treated in an acid bath until all the silver was eaten out to a certain depth, thus leaving surfaces of pure platinum with silver-platinum alloy core.

Early in the 'forties the employment of india-rubber began to engage the attention of the dental profession.

An article in the *Lancet* of June, 1845, by C. H. Stearns, surgeon, records for the first time the use of vulcanite in oral surgery. Describing a "New Instrument for Imperfection of Speech" to wit, an artificial flexible velum - the author says: "This part of the instrument is constructed of Mr. Goodyear's preparation of caoutchouc, which, having the property to resist the action of both oils and acids, and at the same time sustaining a high degree of heat, has proved well adapted to the purpose."

In a later article, "Observation on Congenital Fissure of the Palate," Mr. Stearns tells us, with reference to the construction of an obturator: "I soon found that I was in possession of a material which could be moulded to any required shape, possessing the highest degree of elasticity and also the property of resisting the action of many of the most powerful agents of decomposition."

For some time the inadequacy of the vulcanizing apparatus limited the use of rubber for dentures, but in April, 1859, C. S. Putnam, of America, read a paper to English dentists before the Odontological Society, and presented his portable self-circulating steam vulcanizing apparatus. He stated that in 1855 Mr. Goodyear brought to his office in New York samples of hard vulcanite in sheets of an ebony black, requesting experiments for its application to dentistry.

Putnam also related that T. W. Evans had informed him that he had made some trials on behalf of Goodyear in 1851 or 1852, which were the earliest attempts to make a practical piece. In the discussion, Edwin Saunders, who had tried vulcanite, likewise Cartwright and Tomes, gave their support to the new material for dentures, and fortified it with weighty reasons.

Ash & Sons had already a vulcanizer in hand, the use of which they demonstrated at Broad Street by Mr. Childs, who, at a subsequent meeting of the Odontological Society, showed his patent superheated steam vulcanizer, of which the present Ash's vulcanizers are the lineal descendants.

It will be remembered that we remarked in the beginning of our Memoir that Mr. George Ash was one of the sons who joined his father in the work of the dental depôt. For some considerable time, however, he devoted himself to dentistry, being apprenticed to Mr. Thomson, of George Street, and, after his term of study and apprenticeship, practised professionally for a short time. It was Mr. George Ash who devoted himself to the manufacture of rubber and safe vulcanizers, and it is now common knowledge that of all the rubbers that were ever put on the market, Ash's are the most noted for their variety, beauty of colour, and strength and durability. Mr. George Ash was a constant visitor at the meetings of the Royal Institution. He was of a retiring disposition, and his chief occupation was study and experiment relating to dental material and apparatus, all on behalf of the house of Ash. Indeed, the reforms which he gradually introduced into Ash's factory at Angler's Lane, Kentish Town, which was established in 1862, went far to give the firm that importance which it enjoys to-day.

At a discussion which was held at the Odontological Society in 1861, Mr. Harrison, in discussing Edwin Truman's gutta-percha for dental bases, made these remarks: "It would be difficult for me to determine what amount of durability in any basis for artificial teeth ought to be satisfactory to us as a profession, but I would answer Mr. Truman's question by saying, speaking in general terms, that a basis cannot be too permanent; and I would illustrate the feeling of the profession on this point by referring to what I may term 'the fate' of bone-work, which I believe most of us are now giving up I certainly am *for vulcanite*, on account of the liability of bone-work to decay after a comparatively short period of use. I believe I shall be considered correct in saying that we look upon work made of the hippopotamus tusk as being likely to last in the mouth, on an average, three or four years. I have met with cases in which such work has been destroyed in the mouth in the course of a twelvemonth, whilst, on the contrary, I have seen cases where the tusk of the hippopotamus or walrus has been worn in the mouth for eight or ten years, and has come out of the mouth in as good a state at the end of that time as when it went in, and, indeed, seems to have become harder by wear; but these are exceptional cases. Now, personally, I should be unwilling to give up bone, even for a material which is more durable, unless that material possess some other very peculiar advantages—which, excepting its plasticity, I think it must be

admitted gutta-percha does not—and I would add that when we have discovered a material applicable to our purpose more durable than bone, and which is at the same time unobjectionable in its general qualities—*like vulcanite*—I should incline to the use of that material rather than to the use of gutta-percha, with my present experience of it."

1820

After 1868 vulcanite dentures became the order of the day and the property of the multitude.

Gutta-percha, by the way, was first mentioned by Dr. Montgomery in 1843, brought over to England by Dr. D'Almeida, and, as we have seen, found many useful applications in dentistry.

Among the various notable dental innovations of last century was the

Central Depôt—5 to 12, Broad Street, Golden Square, London, W. 1.

1920

introduction of plastic impression composition. Previous to this, the profession used beeswax for taking impressions of the mouth, and as recently as 1880 there were still some old practitioners who preferred this natural product to any other material.

About the year 1856 C. Stent, of Coventry Street, a shrewd little man with an inventive mind, brought out a composition which was successfully tried by a few dentists, and, shortly afterwards, was favourably discussed at dental meetings. In 1857 Sir John Tomes, having tested it, spoke highly of its utility and reliability as an impression material.

He said before the Odontological Society in 1857, as to the preparation sold by Mr. Stent, he had used it only for the last fortnight, and in about half a dozen cases, and had found it answer very satisfactorily. The material hardened in the mouth so quickly that it was not liable to any distortion in removing it. Mr. Sewill, who declared some years later that "Stents" composition was a good material, said it did not contract or become sucked if left long enough. The testimony of these and other eminent dentists brought Mr. Stent a ready sale.

Time has justified his endeavours as an inventor, and now, as then, his composition stands pre-eminent as an impression material—so much so, indeed, that sometimes impression materials which are not entitled to be called "Stents" are loosely described as such.

For many years now the house of Ash has been the sole manufacturer and owner of the proprietary rights of the genuine Stent's impression composition.

Short of the absolute prevention of decay, there is no more important dental operation than the filling of teeth. Ever since dentistry has advanced any claims for rational methods of treatment, it has sought to repair such organs as it was possible to save. Seeing that the loss of one or several occluding teeth will sooner or later cause the loosening of their opponents, with the incident disadvantages of producing toxic conditions of the mouth, with general ill-health, surgeon dentists have recognised the necessity of keeping every reparable tooth in the patient's mouth.

Quite early in the history of our calling, teeth were stopped with mastic, wax, lead, chips of rock—the forerunners of Mr. W. Dall's beautiful porcelain stoppings—and with gold.

Nothing being known of asepsis, charlatanism being rife in all countries, and medical superstition employing the most nauseous and absurd remedies on the teeth, one need not wonder that the chief cure for an aching tooth was the chisel and hammer, the awl, the powerful tooth key, and finally the forceps. In fact, during those empiric periods this rough operation was the simplest and the best.

Exterior View —Ash's Factory, Kentish Town, London, N.W. 1.

When we reach the nineteenth century, we find already many European and American dentists who enjoyed a reputation for their skill in plugging teeth with tin and with gold. Waite, Leonard Koecker, and James Bate were famous in this respect in the 'forties and 'fifties; the last-named stated truly: "Filling, considered in its highest acceptance, is the summit of our art." Koecker made an important innovation in filling with gold over an exposed pulp, after slightly cauterizing with a hot iron, and placing a lead cap between. Professor Harris performed the same operation in America by a different method. Dr. Crane was another expert gold-filler, whose practice went back to 1829. About the 'forties, rubber and wood wedges were used for separating the teeth in order to reach approximal cavities. How terrible the work of filling was for the patient may be gleaned from the remarks of an old-time gold-filler: "Operators must not be deterred by the sufferings of their patients from removing every particle of diseased substance, and must not yield to the prejudice of people against the use of the file." The development of the use of various plastic filling materials and the improvement of instruments has removed those terrors of an earlier generation.

Jacob and Hill brought in a new material for filling – to wit, gutta-percha, which had an uphill fight to get a footing in the operating-room, notwithstanding its utility.

The most desperate struggle, however, occurred with amalgam in 1845. This alloy of tin and silver, combined with mercury, had a great vogue with the less cultured mass of the dentists, but in the more eminent and official circles of the profession, with but very little exception, there was violent opposition against it, particularly in America. As a filling material it is unique, perfect in every respect, except in colour, and of great durability, and has been, and is still, used in a vast number of cases. There was, however, a strong belief that the mercury used with the alloy was most deleterious to health. This notion has long since been exploded, but the American Society of Dental Surgeons pronounced the use of amalgam – indeed, of all so-called plastic fillings—"malpractice." It issued a disciplinary document to its members, requiring a pledge to abandon its use on pain of being expelled from the Society. The majority surrendered to this ukase, but the stiff-necked outsiders won the race in the end. We recall these facts because it is hard to realise in our days what barriers of prejudice had to be overcome by an article which for years has been in everyday use.

In the United Kingdom amalgam soon overcame all opposition. Sullivan's copper amalgam is mentioned by Clark in 1851, and as far back as 1858 Ash's amalgam had proved the excellence of its quality.

Part of one of the Moulding Rooms in Ash's Factory, Kentish Town, London.

Herbst and Richter some thirty years ago introduced glass fillings, which were tried, but with poor success. These were followed with fused porcelain inlays, which were much used for some years, and still have many adherents.

Cements, with oxychlorides and oxyphosphates of zinc, marked a further step in the development of material for conservative dentistry, and one of the earliest to be produced was Rostaing's. For many years German chemists held the lead in the manufacture of dental cements, but in England Thomas Fletcher, of Warrington, produced an excellent material, widely known as Fletcher's "dentine," and nearly blinded himself during the experiments by which he sought to obtain the ideal "white enamel." Since the production of the materials named, vast strides have been made in the preparation of silicate cements.

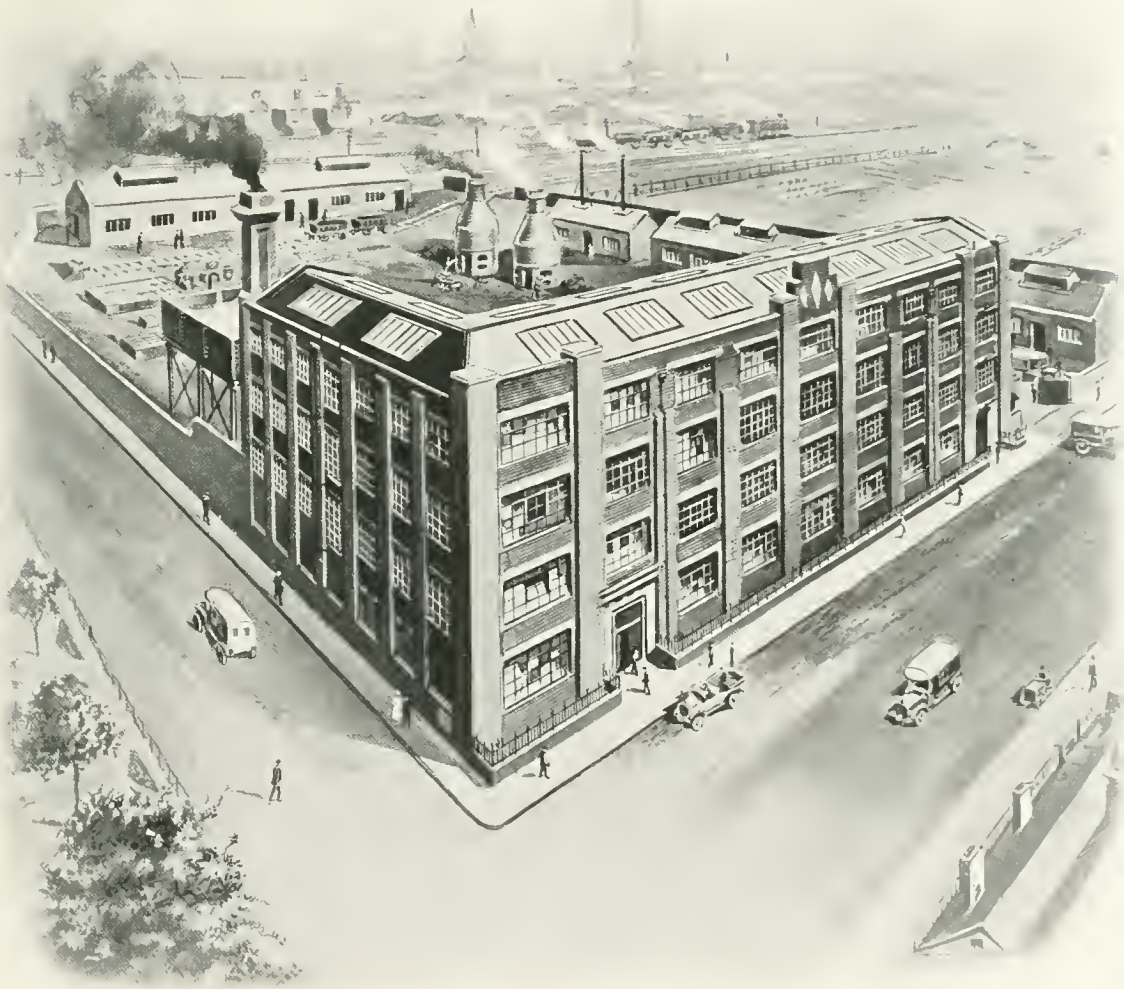
For many years experiments were made towards producing a cement which would be more translucent than the oxyphosphate of zinc—amongst others by Dr. Rawitzer, a German chemist working for C. Ash & Sons, who most successfully achieved a translucent silicate cement.

Ash's silicate porcelain cements, with their great range of colours and adamantine hardness, are a substantial advance on all others. Their oxyphosphate of zinc cements for setting bridges, crowns, and inlays, have been greatly improved, do not shrink or expand, and with complete adhesion to the walls of the cavity make an ideal filling.

Ash's Zincup white copper cement is highly esteemed for its general utility, and is the most reliable cement for filling children's teeth. It is also invaluable for the fixing of gold inlays cast with the Solbrig pliers or press. Years ago an American—we believe, Eleazar Parmly—lamented that he could not cast gold into a cavity and so obtain a perfectly fitting gold plug. It was Leger Dorez who first suggested the casting of a gold plug by means of the blowpipe.

For ages mankind had to suffer cruel pains under surgical and dental operations before a new era was ushered in by chemical investigation and experimental research. Thus, among the epoch-making discoveries of the nineteenth century was that of anæsthesia.

From the earliest times men had endeavoured to overcome pain during surgical operations. Pliny and Dioscorides, have given prescriptions for wine that had the power of rendering the person unconscious to the fire of the cautery and the cut of the knife. Sir Benjamin Ward Richardson, carrying out the Dioscorides prescription, "made his anæsthetic wine of mandragora, and found that it did actually produce the required narcotism in such good form that, in the absence of the more manageable anæsthetic agents we now possess, it might still be used with success by those who have to wait for the surgical ordeal of knife or cautery, or both combined."



Exterior View—Ash's Excelsior Tooth Factory, Liverpool.

Attempts had also been made in the past to induce local anæsthesia, and Dr. Richardson quotes the instance of a Neapolitan, in one of the fencing schools of Naples, who had discovered the fact that, by applying a glass flask charged with crushed ice over the surface of the skin, an insensibility could be produced which would be effective in temporarily removing sensibility whilst an operation was being performed. From this endeavour sprang all the subsequent freezing methods for the extraction of teeth, of which the most useful and popular were Richardson's ether spray and chloride of ethyl. The year 1800 heralded the birth of scientific and controlled anæsthesia. Its introduction is due to the immortal Sir Humphry Davy. While Dr. Priestley discovered the first anæsthetic gas—nitrous oxide—it was Davy who, in his modest laboratory at the Royal Institution, experimented with and courageously inhaled it for the first time. He declared: "As nitrous oxide in its extensive operation appears capable of destroying physical pain, it may probably be used with advantage during surgical operations in which no great effusion of blood takes place."

It requires great courage to try an experiment on oneself, but greater still to try it on others. Hence, some forty-six years elapsed before this new agent came within the range of practical application in the operating-room.

Horace Wells, an American of Connecticut, first applied nitrous oxide to dental purposes. All know that his career had a sad and tragic ending. Almost immediately after Wells's introduction of the new agent into dentistry, and before he had received full public recognition as a pioneer, Dr. Morton, a dentist, introduced and administered a new narcotic substance which he called "letheon." It was not quite professional, perhaps, to keep its nature secret, although its odour soon betrayed that it was sulphuric ether. His colleague Jackson, a professor of chemistry, claimed a share in its discovery, although the relative merit of the two is shrouded in mystery. Through Dr. Bigelow, the news of the discovery of the new agent found its way to England, where the first administration of ether took place at the house of Dr. Bootts. During the narcosis, which lasted a minute and a half, Mr. Robinson extracted painlessly a lower molar from the jaw of a lady.

The next operation was the painless amputation of a limb, at University College Hospital, by the famous surgeon Liston, the narcotic being given by Dr. Squire. It soon became the routine of all the hospitals. Liston had acquired such speed under the old *régime* that he could cut off a leg within the minute. So it might be said of him as a patient said of Cheselden:

"So swift thy hand, I could not feel
The progress of the cutting steel."

The next step in anæsthesia was the discovery of chloroform. In the year 1831 Dr. Guthrie, an American chemist, distilled together chloride of lime and alcohol, whence he obtained an alcoholic solution to which Prof. Thomson gave the name of "chloride ether." Dumas separated it from alcohol and named it "chloroform."

Among the anæsthetics we have mentioned, nitrous oxide has been the safest and most widely used. It was not till the late 'sixties, however, that men like Clover—whom we remember, with his old-fashioned skull-cap, administering gas at the Royal Dental Hospital—Alfred Coleman, and others, were the means of introducing nitrous oxide gas generally. Mr. William Henry Ash attended one of the early demonstrations at the house of Mr. R. Hepburn, where some primitive gas cylinders were shown by Dr. Evans, of Paris. Since that period both anæsthetists and manufacturers have perfected methods and apparatus, and anæsthesia is now a highly developed science with a valuable literature.

Some thirty years ago the arrival of cocaine brought in its wake a number of new local anæsthetic combinations which have become powerful competitors with gas and even with N_2O and O, which Hewitt introduced to the dental profession with signal success.

The successive developments of the dental art—with only a few of which we have been able to deal in cursory fashion—were the result of invention on the part of dentists, doctors, or chemists, brought, in most cases, to the manufacturers, who were largely responsible for their practical application and subsequent improvement.

For the high degree of perfection now reached we have to thank the collaboration which has existed between the profession and the actual manufacturer to a much greater extent than is, perhaps, realised to-day by many who know dental depôts as developed commercial businesses, and who probably have not given thought to their past history.

The house whose early days we have already described grew with the development of dentistry, the founder, Claudius Ash, and his two sons, George and William, being in close contact with the dental profession through its most distinguished members. George Ash, as we have already stated, studied dentistry and practised it for a time, relinquishing the profession only in order to give his whole attention to the manufacturing side of the business, while his brother William more particularly devoted himself to the accounts and organisation. Mr. George Ash's temperament was that of the student and experimenter, and he constantly attended the meetings of the Royal Institution. It was mainly due to his ability that the factory which the firm established

in 1862 at Angler's Lane, Kentish Town, acquired pre-eminence in the production of dental rubber and vulcanizers, in addition to the mineral teeth which had been their original product.

For many years a factory at Walton-on-Thames, developed by Mr. Edward Power, worked exclusively for Ash's in the production of chairs, engines, forceps, and tools, until the time came when it was taken into, and became a corporate part of, the Company. In the same way, Mr. John Law, of Edinburgh, with his sons, worked for many years exclusively for Ash's in the manufacture of fine steel instruments, and the business was eventually disposed of to the Company, which has now for many years been able to produce in its own factories every class of article employed in dentistry.

Coincident with the development of the manufacturing side of the business, the distributing organization was evolved, and in course of time the central house in London expanded from the single house in which it had its origin into a great building covering the sites of no fewer than eight houses, namely, 5, 6, 7, 8, 9, 10, 11 and 12, Broad Street, Golden Square, and opened branches between the years 1856 and 1860 in Liverpool and Manchester, and later in Edinburgh.

Following the French Exhibition of 1867, a branch was opened in Paris under Mr. Ruyssenaers. In 1873 a Scotsman, Mr. Colin Logan, an old employée of the London House, took charge of the French business and carried it on for some thirty years. With the interim direction of Mr. Percy Ash, and the appointment in 1908 of Monsieur Platschick, who is the present Manager, a great impetus was given to the business in the Republic.

In 1909 branches were established in Lyons, Marseilles, Bordeaux, Brussels and Madrid, and a factory was developed in Paris, and to-day Ash's business in France alone employs more than 250 persons.

In the same year in which the Paris Branch was opened—viz., 1867—the House established its first branch in Germany by opening a depôt in Berlin. This was under the direction of the late Mr. Daniel O'Connell Finnigan, an Irishman of remarkable talent and commercial aptitude, who, besides developing the business in Germany very largely, extended the activities of the House upon the continent by inaugurating branches in St. Petersburg, Vienna and in Italy.

With the development of dentistry in the continent of Europe, the principal branches thus founded subsequently developed sub-branches, so that by the end of the nineteenth century we find the House represented by its depôts in Hamburg, Frankfurt, Munich and Breslau under the Berlin management, in Budapest and Lemburg under Vienna management, and in Moscow, Kieff

and Odessa as extensions of the original branch in St. Petersburg, while in Italy it had depôts both in Rome and Milan.

In the Scandinavian countries it has for many years had branches in Copenhagen, Christiania and Stockholm; the House flag flies in Amsterdam, Brussels and Zurich, whilst for the Levant it established itself in Constantinople, and for Egypt in Cairo and Alexandria.

The House has been represented in the United States since 1886 by Mr. C. A. Sykes, who opened a branch in New York in that year. In a country in which the designing and manufacturing of all appliances required for the practice of dentistry has been so highly developed, it was no light task for the representative of an English house to gain a secure foothold, and that he has been able to do so is testimony, not only to his personal ability, but also to the quality of the products which he introduced to a critical professional public.

For many years Mr. Sykes visited the principal cities of Canada, introducing Ash products, and in 1908 he opened a branch in Toronto.

All these branches and establishments, at home and abroad, are supplemented by a number of travellers, and the close relationship between the House of Ash and their clients is best exemplified by the volume of their home and export trade, which covers all our colonies and every country under the sun.

It is interesting to record that great grandsons of the founder, Claudius Ash, are Managing Directors at the present time, so that four generations of the founder's family have assisted in the development of an industry essential to the health of the nation.

MINERAL TEETH:

PROGRESSION OF THE ART FROM STAGE TO STAGE.

The first paper of this Memoir gave a short account of the early period of tooth manufacture. In the following pages we will endeavour to review the stages by which the art has subsequently progressed.

We cannot do better than reproduce a few photographs taken from the

Fig. 1.

collection in Ash's Museum, and will begin with a set of the so-called "terro-metallic" teeth, which were made of a material little better than china—brittle, and crude in form (see Fig. 1).

Fig. 2.

Fig. 3.

The second illustration shows similar teeth of an improved mineral composition; while the third gives an early example of an Ash tooth, and is noticeable as illustrating a marked improvement in the art of mould-making.

All of these teeth had small platinum points or loops to which wire was soldered, the wire, in its turn, being riveted to the plate; to mount such teeth upon a true-fitting backing was impossible.

The next step was the development of the Tube Tooth, and Figs. 4 and 5 show early examples of this form of tooth, which was brought to a high degree of

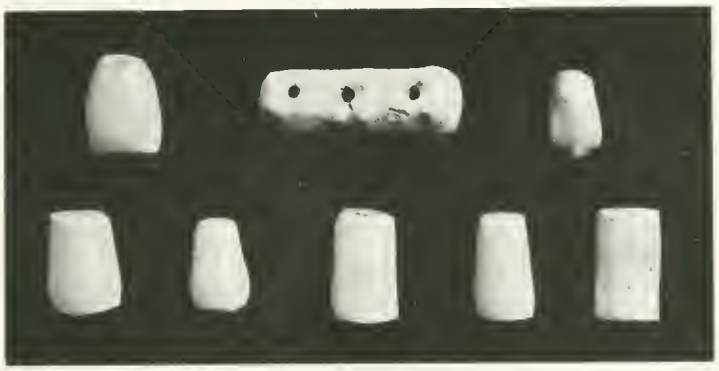


Fig. 4.

perfection by Claudius Ash between 1837 and 1840 (ref. Fig. 6). For some years the tube was made of gold, and was inserted into the tooth after it had been fired and reamed out; but, later, the use of platinum made it possible to fire the teeth with the tubes already in them. The pivot tooth was a modification of the tube tooth, and was often mounted on roots by the insertion of a wooden pivot, which occasionally expanded to such an extent that it cracked the root.

Fig. 5.

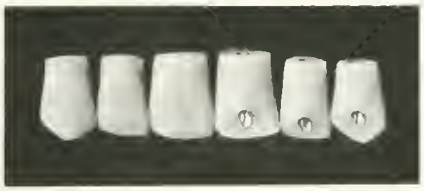


Fig. 6.

About 1850 flat back teeth were introduced, with short pins which were riveted to the backing plate, also flat back teeth with platinum bars instead of pins, and, with these and tube teeth holding the field for plate work, we do not find any marked alteration in form until plastic materials became available for dentures.

With the introduction of vulcanite, and subsequently celluloid, came various designs of pinless teeth, of which Figs. 7, 8 and 9, illustrated on the following pages, show some examples made by Ash & Sons between 1858 and 1870.

Pin Teeth were easily adapted for use with vulcanite by providing them with pins long enough to be bent to form a hook or anchor in the rubber, or by giving them headed pins.

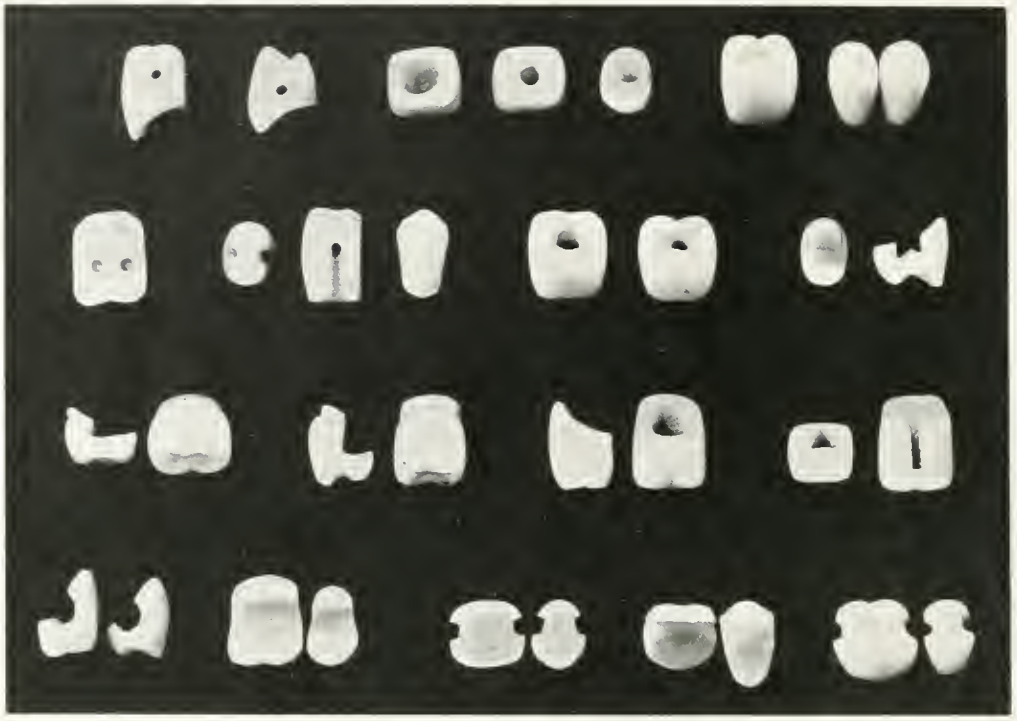


Fig. 7.

Fig. 8.

The open crown bicuspids and molars shown in Fig. 10, and the anterior teeth with deep dovetailed groove and a pin shown in Fig. 11, were appreciated

Fig. 9.

for a time, but the only tooth specially designed for vulcanite work which proved to be really practical was the Diatoric, designs of which are shown

Fig. 10.

Fig. 11.

in Fig. 12. Of these, the form with a dovetailed projection, produced by C. Ash & Sons, was firmly established as the best by 1875.

Fig. 12.

The latter part of the nineteenth century saw the introduction of various designs of crowns, some with pins or posts fixed in them, and others with the post independent; and of these we illustrate Ash's Dowel Crown (Figs. 13 and 14), of which more anon.

Fig. 13.

As we trace the history of artificial teeth throughout the past 100 years, we are confronted by a curious paradox, inasmuch as we find that the type which was most generally in demand in the later periods was inferior in many respects to the type of tooth which it had supplanted. Such a contradiction to the ordinary law of progress needs investigation, and may be explained, we believe, by the fact that the great majority readily adopts the line of least resistance; or, in other words, that the tendency is to take up an easy method of work in preference to a more difficult one. That the easier method in the case of artificial teeth was not one which gave truly better results, is admitted by many leading members of the profession, yet it was almost universally adopted!

Probably the explanation of the displacing of the tube tooth by the pin tooth or facing is to be found in the fact that the introduction of the easier work came at a time when the still limited numbers of dental workers, operators and mechanics, was on the eve of a very considerable expansion, and that the popularising and cheapening of dental work (prosthetics) due to the introduction of vulcanite, inclined men more and more towards methods of rapid production. Consequently, the increasing numbers of the younger generation were not trained to the older method.

This aspect of the matter is discussed in the introductory chapter of Girdwood's treatise on "Tube Teeth and Porcelain Rods" (1918), a very comprehensive and informative work. The author, it may be noted, considers it surprising that interest in tube teeth should have declined, but records the fact that their use has never been actually discontinued by the best class of British practitioners. That there are signs of reviving interest in these teeth is, in Mr. Girdwood's opinion, fortunate; and, indeed, this view has very substantial support, for, in their strength, appearance, and great adaptability, the tube teeth possess highly important and valuable attributes.

With the introduction of casting the irksome task of fine-fitting each tube tooth to a plate, which was the only method known of old, has been done away with; in fact, for cast gold work, whether plate or bridge, the tube tooth and dowel crown possess marked advantages over pin teeth, and lend themselves admirably to a simple method of setting up which may be briefly described as follows. After waxing up the plate or bridge on the model, posts or dowels are set in the wax and the teeth are mounted upon them with their bases in the softened wax. When the case has been tried and adjusted the teeth are removed, leaving the posts in situ, consequently the teeth are not subjected to any risk during the process of casting, and only need to be fixed on to the finished plate with an oxyphosphate cement.

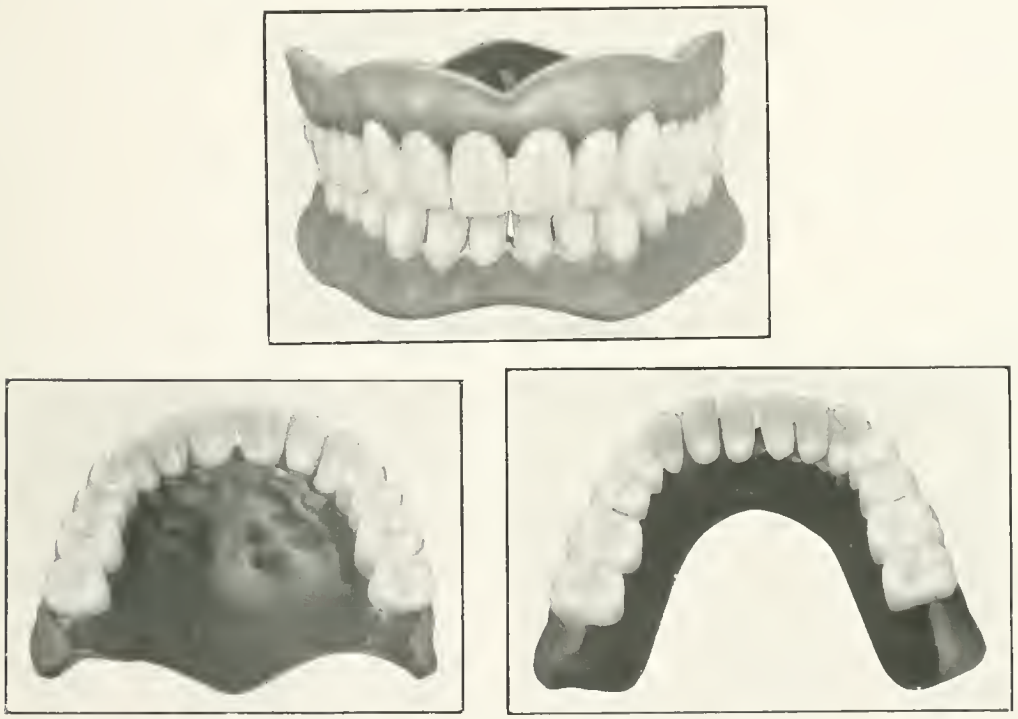


Fig. 14.

The Dowel Crown, like the tube tooth, can be used in plate or bridge work, and of recent years methods have been devised for its use in vulcanite dentures.

One of the first of the special features to be noted in regard to the use of Dowel Crowns and Non-Platinum Tube Teeth in vulcanite dentures is the extra room which is gained in the mouth for the free action of the tongue. This advantage is due to the fact that the lingual surfaces are not backed with vulcanite as is the case with pin teeth. For the same reason they possess a high degree of translucency, and a pleasant feeling of cleanliness is obtained by the contact of the tongue with porcelain all round the denture.

The possibility of spacing and setting them up irregularly without exposure of the rubber is one of their marked advantages, and, as the highest art is the concealment of art, so these teeth lend themselves to an artistic irregularity of setting up whereby the appearance of artificiality is eliminated.

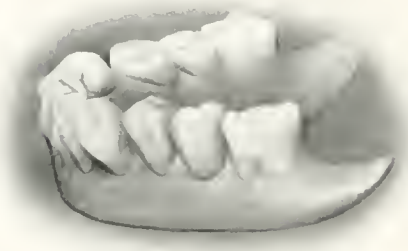


Fig. 15.

Fig. 16.

Fig. 15 and Fig. 16 illustrate the adaptability of tube teeth to irregular cases, which could not possibly be suited by flat or other types of teeth. The naturalness of the effect obtained is a point well worth noting; moreover, however closely or irregularly the bases may be set together, open cleansing spaces are always presented.

Practitioners who have had long experience with these teeth have been astonished at their wonderful strength; they will withstand almost any pressure to which they may be subjected, even when they are ground down to an apparently dangerous thinness.

A further useful addition to the range of teeth which we have described is to be found in Ash's Bridge Tooth.

Fig. 17.

As will be seen from the illustration above (Fig. 17), it is a modification of the Tube Tooth, inasmuch as its base is cut to a curve which shortens the lingual wall and leaves good clearance, and, in place of a tube passing through the centre of the tooth, it has a hole for the main post running in the direction of the buccal cusp where the greatest bulk of mineral is to be found, and a shallower hole to receive a short post for further anchorage upon the base and to eliminate any possible risk of rotation.

Fig. 18.

Fig. 19.

Figs. 18 and 19 show the buccal and lingual aspects of a bridge-denture consisting of three all-porcelain crowns—Ash's Bridge Teeth.

The former illustration conveys a good impression of their natural appearance, while from the latter can be seen the ample clearance obtainable between the denture and the alveolar ridge.

Their adaptability is such that the work of making a bridge is simplified to a far greater extent than has been possible with any tooth yet introduced.

The facing here illustrated (Fig.20) was suggested by Dr. Wayne as providing a quick and easy method of repair in any case in which a pin tooth was broken leaving the heads of the pins projecting from the backing. The oval cavity in the back of the facing corresponds with the position of the pins according to the size and width of the tooth to be replaced, and a repair is easily effected by cementing the facing on to the backing.

This facing lends itself equally well to original plate or bridge work if a little stud be made to project from the backing.

Fig. 20.

Stud Head projecting from backing.

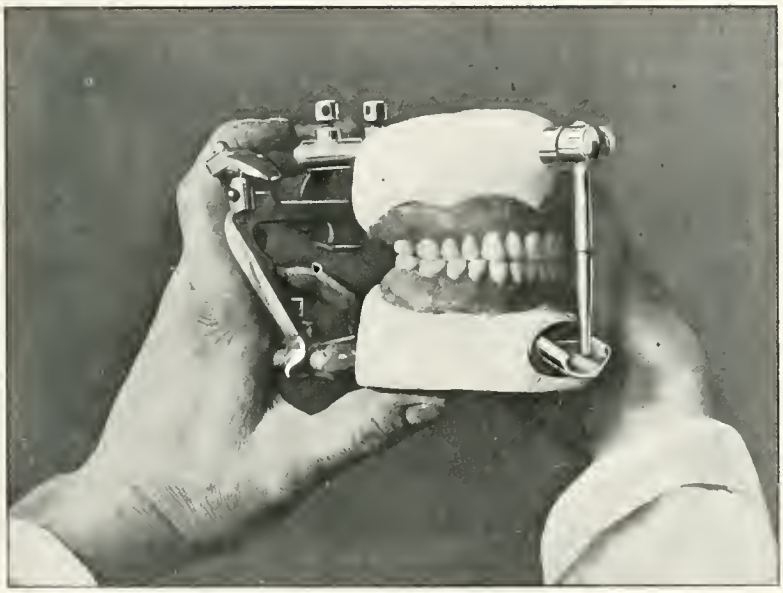
Repair Facings cemented on to Studs.

The present century has seen the development of interchangeable facings, but principally the last twenty years have been occupied in the improvement of the designs of teeth, particularly in the posterior region, as a result of the increased amount of study devoted to problems of articulation by members of the profession.

The invention of the Articulator is attributed to J. B. Gariot, who, about 1805, devised a simple form of this now well-known instrument. Thereafter, various types of articulators were introduced; but the half century following Gariot's invention was essentially an empirical period, wherein the work devoted to articulation was mainly tentative.

It was reserved for Dr. G. W. A. Bonwill, of Philadelphia, to disclose the scientific aspect of this subject when, in 1864, he enunciated the principles upon which his method of antagonisation was based. Many other workers now entered the field, and showed a laudable spirit of emulation in research.

The illustrations on this page are of interest as having reference to the articulation and occlusion of artificial teeth.



They present two views of Ash's anatomically articulated teeth, showing perfect contact of cusps both on the masticating and on the balancing side during the lateral movement of the mandible.

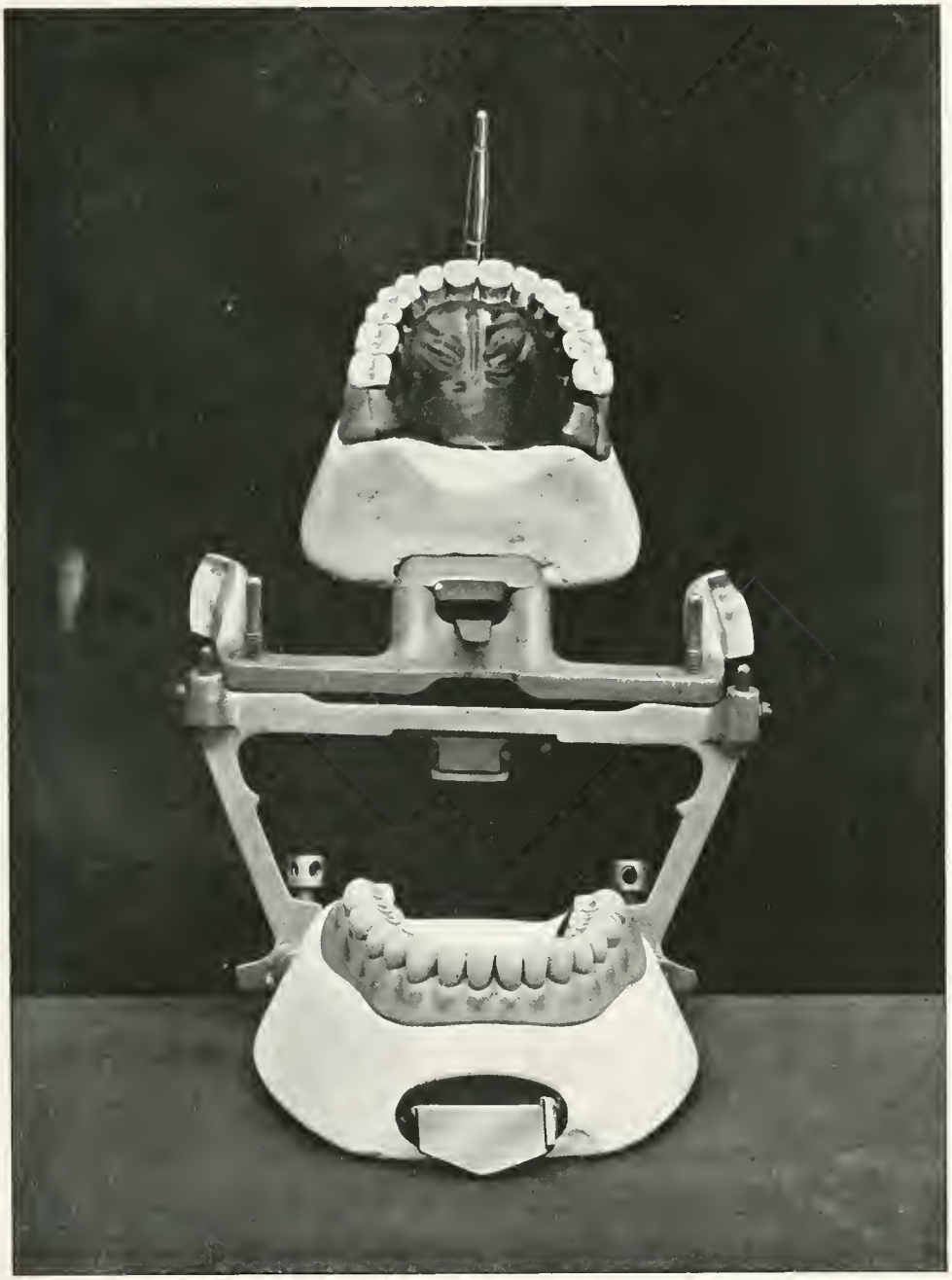
In view of the manifest desirability of a method of mounting dentures whereby it becomes possible not only to secure occlusion, but also to reproduce accurately the masticatory movements of the natural teeth, it cannot be doubted that the community has derived exceptional benefit from the labours of Bonwill and of all who have come after him in perfecting the means to so important an end. Many names might be mentioned in this connection, notably those of N. Bennett, G. Campion, Christensen, Constant, Dolamore, Francks, Gritman, Gysi, R. E. Hall, Krabbe, Luce, Morton, Parfitt, Robinson, Schwartz, Victor Smith, Snow, Spee, Sternfield, C. Tomes, Turner, Walker and Warnekros. Their cumulative achievements represent a very great advance in prosthetics. They have contributed enormously to the progress of recent years towards perfection in artificial dentures, and have laid down a firm foundation, scientifically sound, upon which the dental worker can build with hope of realising his ideals.

Particularly noteworthy have been the results arrived at by Professor Dr. A. Gysi, and exemplified in his Three Point Articulator, which has the object of making the teeth themselves follow the correct natural movements in opening and closing, in the forward and backward movements, and in the lateral movements both left and right.

The literature of the subject of articulation has, of course, become very considerable. Indeed, it has been a compelling theme for dental writers and teachers, who realise that a vital principle of prosthetics resides therein. The subject is very comprehensively reviewed by Dr. Charles Turner in the "American Text Book of Prosthetic Dentistry."

Mr. Charles W. Robinson's paper on "The Anatomical Articulation and Occlusion of Artificial Dentures" may be instanced as a lucid and practical exposition, readily understandable by any who have been deterred from going deeply into the matter by its technicalities and seeming intricacies.

A natural outcome of the intensified study of the problem of the articulation has been the increased knowledge of the needs of the profession which dental manufacturers have thereby acquired. Ash's, needless to say, have watched closely, and with much more than a mere academic interest, the course of research and invention in this domain. Just as Claudius Ash, from 1830 onwards, made teeth in accordance with the advance of prosthetics in his generation, so his successors, the present firm, have been prompt to provide for the requirements created by the newer research, and all the latest of their teeth are of the proportions which modern study has established as anatomically correct.



Full upper and lower denture of Ash's anatomical teeth set up with compensating curve (ref. curve of Spee), which will give perfect masticatory and balancing contact during the mandibular movements.

CHAIRS.

In times long past, the surgeon, when about to extract a tooth, would recommend the floor as the best seat for the patient, and the latter's head between the operator's knees as the preferable attitude. The victim, being thus, to a large extent, deprived of the power of movement, played a comparatively undistinguished part in the ensuing drama.

This Spartan method yielded at last to the assaults of reform. Chairs of simple construction came gradually into use, and by the year 1831 James Snell had evolved one which embodied in embryo a good many of the advantages we see in dental chairs of to-day. This early type was succeeded by designs more elegant and still more efficient such as Owen's and Betjemann's, followed by Morrison's, Wilkerson's, and others. Subsequent developments have been all in the direction of increased resource, facility, and comfort.

Of such importance is the furnishing of a dental surgery, that no amount of attention given thereto can be deemed excessive. The benefits resulting will more than compensate for the time and thought bestowed. First among things to be borne in mind is the nervous temperament of the patient. The majority consider a visit to the dentist an ordeal; many contemplate it with dire forebodings. It is, therefore, the judicious practitioner's aim to keep the operating-room, as far as possible, free of the association arising out of its daily use, and to create in it an atmosphere that will overcome the tendency of the average client to regard it with aversion.

Next come the convenience and welfare of the operator himself—to be secured by furniture and appliances of the time-saving and sanitary type, so arranged as to promote ease and celerity. The Dental Chair is, perhaps, the outstanding necessary item in such modern equipment. Properly designed, it is conducive to quick and accurate working, agreeable to both patient and operator; and if the design be also in a true artistic spirit, there is introduced a psychological factor of real value. Most people are susceptible to the tranquillising influence of the beautiful and the refined.

Throughout the greater part of the one hundred years during which Ash's have been supplying the needs of the dental profession, they have given considerable attention to Chairs; and the expansion of this section of their business is evidenced in the enormous demands they are called upon to meet. Our illustration shows one of Ash's "Empire" Chairs, a product of the firm's Walton-on-Thames factory, and an example of the advanced class of work that is now in favour.

CABINETS.

English cabinet work was of recognised excellence as long ago as the Middle Ages. There is cause for gratification, therefore, in the knowledge that the standard of merit in this branch of our national craftmanship is being worthily upheld to-day. The eighteenth century might be termed the classic age of cabinet-making in England. Art-forms were then conceived which are still universally admired. The fame of our old masters of *ébénisterie* was not for an age only. It lives, and will live. Their artistic triumphs continue to inspire us, and it is a proud privilege to work for the maintenance of the traditions they bequeathed.

The application of fine cabinet work to the purposes of the dental art constitutes a phase of the development which we are reviewing in these pages. Nor is it a phase of minor interest, but one closely in keeping with the trend of modern thought and idealism. The desirability of creating in a dental surgery a gracious atmosphere has already been accentuated. In really fine cabinet work one of the most valuable constituents of such an atmosphere is found. Its salutary effect upon a patient's nerves is by no means negligible, and it makes for that amenity of surroundings wherein the dentist may well find greater zest for the daily tasks of his practice.

There is, further, the important consideration of convenience. The British craftsman is scarcely excelled in his power of grafting the practical upon the artistic. A thing of beauty will often leave his hands a thing of utility as well. In the best dental cabinet work he finds ample scope; for this should be handsome, and must be useful.

As far back as the middle of last century, Ash's made Dental Cabinets. Their work in those days, though sound and durable, was, perhaps, rather frankly utilitarian. Its severe simplicity of design has been greatly modified in later years by recourse to the higher art-forms of the "classic" periods. Infinite care has been exercised by the firm in assuring themselves of the services of a staff not only technically skilled, but imbued with the true art-craftsman's instinct. The effect of this careful selection of workmen is seen in the many examples of finely executed cabinet work produced by the house at the present time.

On the page opposite appears an illustration of one of Ash's Combination Cabinets and Outfits, in best figured walnut finish. It derives its beauty of design from a very old "Sheraton" cabinet, and its utility from a plenitude of drawers and cupboards for instruments, etc., together with complete electrical and compressed air equipment for the control of the surgery outfit.

CEMENTS.

It would be difficult to state, even approximately, the period at which cement actually originated. So long has this class of material been used, that one feels that it never was invented, but simply "occurred" the result, perchance, of one of those fortunate accidents which have so often added to the resources of human life. We do know, however, that scientific experiment has developed it from a crude to a highly refined state.

Although cement in its various forms has been in use for centuries, it was not introduced into dentistry until about fifty years ago. One cannot say that it met with a very favourable reception by the dental profession. With some of the writers of those days it was a rule to denounce the use of cements as a species of malpractice, and dire were the injurious effects ascribed to these substances. One writer said: "I regard cements, fusible metals, amalgams, and all other substitutes for gold, as impositions on the public. . . . I have never known a perfect master of the art of stopping teeth either to employ or recommend the substances which I here condemn."

That such views were the result of biased and ill-formed opinions, based upon impressions which had no scientific foundation, goes without saying, and we feel that it is hardly necessary to refute them before the present-day practitioner, who, without doubt, has proved that cement serves many important and useful purposes- so much so that it is now regarded as indispensable.

Oxychloride of Zinc was the first cement to be introduced. This proved of great value, especially as an obtundent of sensitive dentine in shallow cavities; but, owing to the caustic nature of zinc chloride, it was found to cause acute irritation of the dental pulp. Consequently, it soon lost favour, and was eventually succeeded, in general use, by Oxyphosphate of Zinc and the Oxyphosphate of Copper which was introduced some years later. Owing to its strong antiseptic properties, Oxychloride of Zinc is still, however, regarded as a most excellent material for filling roots.

The limitations of these filling materials were fully recognised, and for years many keen and agile brains had been searching unwearyingly for the cement which would fulfil every requirement. Many and bitter were the disappointments which attended such researches, and no account of the efforts to discover the ideal white filling would be complete without a tribute of praise to the late Mr. Thomas Fletcher, of Warrington, who laboured long in the cause, at the cost of a small fortune.

Unhappily, he did not live to see his ideal realised, which fell to the lot of Professor Ascher, of Berlin, a few years later. His success, without doubt, marked an achievement in the dental world yet to be surpassed, and the greatly improved forms now available are its direct outcome.

Perfect Reconstruction
of the
Natural Enamel.

AMALGAMS.

Only those who are familiar with the numerous observations and writings which have been published on the subject of amalgams can fully realise the intense difficulty which it experienced in establishing itself.

From the works of old writers we learn that at its introduction—about the early part of last century—amalgam was almost wholly employed by the empirical practitioner, and very emphatic are these writers in their condemnation, not only of its use, but of its users, of whom many authors appear unable adequately to express their contempt.

For the first amalgam, filings were obtained from silver coins. Five-shilling pieces were used for preference, and in those days the filing of coins became quite part of the workroom routine. Later, it was discovered that the addition of tin overcame many difficulties which were evident when pure silver was used, an improvement which did much to attract the attention of many respected practitioners and to encourage further research.

There still remained, however, a majority of influential men strongly opposed to its use, who not only considered experimentation as worthless, but denounced the material as being totally unfit for dental purposes.

All the more honour is therefore due to such men as T. B. Hitchcock, John Tomes, G. V. Black and Thomas Fletcher for the great part they played in hastening forward the final demolition of the great barrier of prejudice that had been raised against amalgam.

Ash's took up the problem of amalgam when the controversy was at its height, and in 1850 introduced their No. 1 Gold Amalgam, originally known as "Filings for Metallic Paste." A steadily increasing number of practitioners gave it their adherence, and even the bitterest opponents of amalgam had to take cognisance of what was now being done to refute their arguments and nullify their objections.

For the House of Ash (once the start had been made) a progressive policy in this matter was clearly indicated. Following the No. 1 Amalgam with the No. 2 in 1864, they added the "Imperial" and the "C.A.S." Alloy in 1896 and 1899, respectively; in 1904 they brought out the "Excellent" Alloy as a good cheap amalgam. By their ever-widening adoption, all these have testified to the value of amalgam as a dental filling. It only remains to add that Ash's have now signalised their centennial year by placing their new "Popular" Alloy at the service of the profession.

As a record of the permanency of a good amalgam filling, we illustrate an untouched photographic reproduction of a molar, which, having a cavity filled with Ash's No. 1 Amalgam in 1856, was thereafter in use for fifty-eight years. The tooth, when extracted in 1914 owing to the resorption of the alveolar process due to old age, was perfect.

C·A·S·
ALLOY
FIVE OUNCES
C·A·S
ALLOY
MANUFACTURED FOR
CLAUDIUS ASH, SONS &
LIMITED
5 TO 12 BROAD STREET
GOLDEN SQUARE
LONDON W.I.
CAS
RAPID
SETTING

Ash's Imperial
CLAUDIUS ASH,
5 to 12 Broad Street Golden
ASH'S IMPERIAL
AMALGAM

IMPRESSION MATERIALS.

In searching for data relating to materials used during the past century for taking impressions of the mouth, one is surprised to find that very little is recorded on this subject. A softened form of wax was used at an early period, and the impression appears to have been taken without regard to the conditions affecting the retention of the finished denture. It seems incredible that there should have been any laxity or carelessness in this matter, in view of the fact that the impression is the foundation of a denture—as vitally essential thereto as is a sound and true foundation to a building. Still, whatever the nature of the substance used, or the manner of its application, the beautiful work carried out in the past goes to prove that the purpose was served.

With the modern development of dental art a variety of impression materials came into use. Some have had their day; others remain. Broadly classified, they fall into two principal groups—those which harden by crystallisation, and those rendered plastic by heat. Plaster of Paris is the outstanding example of the former group, wax and gutta-percha may be instanced as types of the latter. Both wax and gutta-percha, however, have now been to a large extent abandoned as impression materials. Plaster and modelling compounds hold chief sway in this domain of prosthetics.

By many authorities Plaster of Paris is considered to be the impression material *par excellence*, and it undoubtedly possesses very strong recommendatory attributes—notably its high degree of plasticity, its rapid setting properties, and the readiness with which it lends itself to the accurate reproduction of irregular surfaces. It has, moreover, the merits of being tasteless, and free from odour, while it breaks with a fracture so clean that the pieces can be easily re-united in their exact co-relationship.

The ideal in anything is difficult to attain, and, with all its good points, Plaster of Paris is not entirely faultless. Its most pronounced deficiency from the dental standpoint is a tendency to expand, both during and after setting, with the result that impressions are liable to warpage after the plaster has set. Needless to say, many efforts have been made to combat this tendency, or, at least, to minimise its detrimental effects; for the possibility of a warped impression, resulting in an imperfect reproduction of the mouth represented, cannot be viewed with equanimity by the practitioner.

On the whole, it may be said that the advantages of Plaster of Paris so far so outweigh its deficiencies that the latter, though scarcely negligible,

constitute no very serious drawback, especially when their nature is understood, and care is taken as far as possible to counteract them. It is likely, therefore, that plaster will continue to hold its place as a "standard" impression material, approximating to the desideratum.

During the latter half of the century of dental progress reviewed in these pages, impression materials in the form of compounds or compositions have obtained very considerable favour. Of these, the oldest, and, it may fairly be presumed, the most popular, is that so widely known to-day under the name *tout court* of "Stents." The Original Stents Impression Composition first came before the notice of the dental profession in 1857; and reference has been made earlier in this review (*vide* page 14) to the circumstances attending its introduction. Its inventor, Mr. Charles Stent (whose portrait is here reproduced) was a dentist, practising at 22, Coventry Street, Haymarket, London, where also he manufactured his impression composition from 1857 until about 1885, when he died. His two sons had joined him as partners during the intervening period forming the firm of C. R. & A. Stent, under which title both the dental practice and the composition business were latterly carried on.

At his death, Mr. Charles Stent left the composition business to his widow, Mrs. Caroline Stent, with whom Ash's subsequently made arrangements to take up the Sole Selling Agency; ultimately purchasing the business outright, and transferring the manufacture to their Kentish Town Factory, where "Stents" is still made.

RUBBERS.

Of all the materials that have been brought into the service of dentistry, there is none which has figured more conspicuously in the modern advance of the art, or added more appreciably to the resources of the prosthetic branch, than rubber. The history of caoutchouc, the elastic, resinous substance which we term rubber, furnishes one of the "romances of commerce." For a long time, the substance appears to have been regarded as little more than a natural curiosity. It was late in the eighteenth century ere it was found to be adapted to rubbing out pencil marks on paper, thus gaining its so familiar English name.

The active scientific and industrial research of the nineteenth century rapidly multiplied its uses, and we have seen how quickly the dental profession seized upon Goodyear's great discovery, and found in vulcanite the long-sought plastic material strong, light, easily manipulated, and capable of resisting the action of the fluids of the mouth. From the introduction of vulcanite as a base for artificial dentures, we date a new era of extraordinary development in prosthetics.

Not without some difficulty, however, did vulcanite attain to eminence in dentistry. Objection to it was at one time raised on the ground that it caused inflammation of the mucous membrane, and so serious did this objection become that (as Dr. Charles R. Turner says) "it threatened to destroy the usefulness of this material in dentistry." But opposition has its uses. Not infrequently it leads to action which removes the causes of objection and disperses the clouds of doubt. In consequence of the attention drawn to the matter, means were adopted which overcame the trouble; while the question of the possibility of a poisonous influence being exerted by the salts of mercury used to colour red vulcanite was also at length definitely set at rest by the report of the committee appointed to collect and examine evidence upon that subject. This report, embodied in the "Transactions of the Odontological Society of Great Britain," April, 1877, detailed the nature of the evidence taken, and stated that the inquiries of the committee had "utterly failed to establish the existence of a single case of unquestionable or even probable mercurial poisoning due to the use of red vulcanite plates."

Meanwhile, at the instance of Ash & Sons, Professor John Attfield, F.C.S., had conducted "an investigation of the influence, if any, of saliva and the other fluids of the human body on the pink and red varieties of vulcanite used by dentists in making artificial teeth-plates, gums and palates." His exhaustive

report was placed by Ash & Sons at the disposal of the above-mentioned committee, and was printed along with their report. It concludes with these words: "I am of opinion that vermilion vulcanite teeth-plates are practically unaffected by saliva or by any substance which ever gains access to the mouth; and, in short, that the pink and red vulcanite artificial gums and palates now so generally worn are absolutely harmless."

Thus cleared of suspicion, vulcanite, one might say, "left the court without a stain upon its character." Still, it has always to be borne in mind that, by its nature, this is inevitably a variable material. As there are many kinds of rubber, so there must be different classes and qualities of vulcanite. Choice of the best for dental purposes is imperative; and it is upon the experience of the leading dental manufacturers that the profession can most safely rely for supplies most suitable for use in the mouth, and of a purity entitled to confidence.

By way of historical record, it may be noted that Ash's became associated with the production and supply of dental rubbers at the inception of the vulcanite era in 1857.

EXTRACTING INSTRUMENTS.

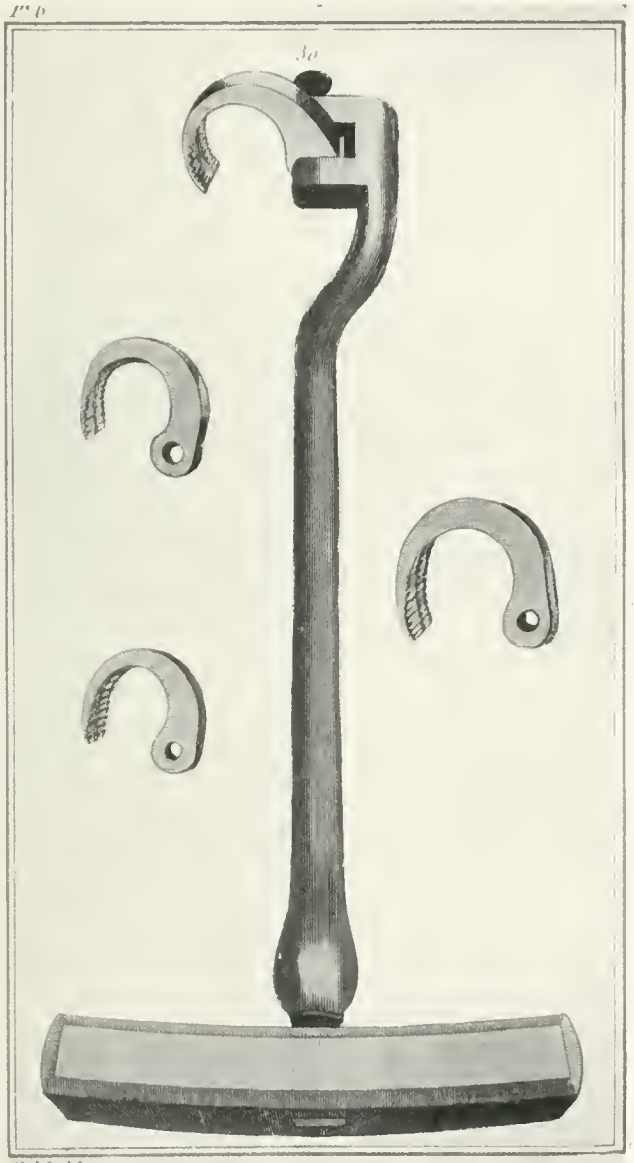
One takes a long look back into the past at the sight of the old tooth key, and the sensitive may shudder a little, for the very appearance of this implement is enough to suggest that pain, amounting even to torture, must often have attended its use. To have lived in the days when dentistry, being in its infancy, had yet to discover the means of obtunding pain, when the only relief from the torment of an offending molar was submission to the agonising application of a clumsy tool, needed courage indeed. Yet it is no uncommon thing to come across people who are ever yearning for the return of "the good old days." They have painted for themselves a picture of grace and tranquillity that suffices to set them envying the race which lived at that period. Surely their minds must, for one thing, be oblivious to the inadequacy of the then existing means of surgery. They must have forgotten that painless surgery was unknown; and were they to ponder this one point for a moment, there is little doubt that their courage would fail them, that their vision of the "good old days" would reveal itself as nothing but a romantic dream, and that their cry would even be, "Away with the past! Let us progress, let us progress!"

So wide a gulf lies between the tooth key of the last century and the forceps of to-day, that it would be impossible to institute a comparison. Still, as one reflects upon the inferiority of the former instrument, a feeling of admiration arises for the old-time dentist, who, in spite of imperfect appliances and numerous other disadvantages, performed his work with no little skill and credit.

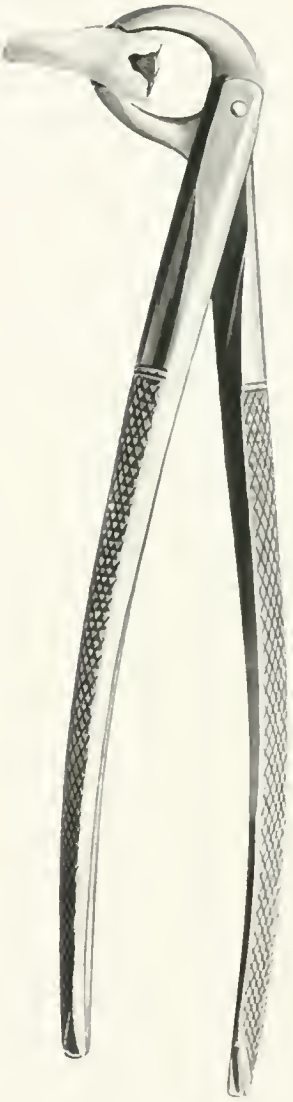
In the manufacture of the modern forceps such points as lightness, strength, temper, finish, and accuracy of adaptation are deemed essential. The anatomical peculiarities of the teeth are also taken into consideration; the beaks of each instrument are made so perfectly to fit the teeth for which they are intended, that a firm grip can be obtained, and sufficient pressure applied for the removal of any tooth without danger of crushing the crown.

Difficult though it is to overestimate the value of the present-day forceps, it would be rash to proclaim them the "last word"—for who knows what the future has in store? It may be that a time will come when such instruments as forceps will be condemned as being no less inhuman than we of the twentieth century consider the tooth key.

Pl. 9



Abel. Le del.

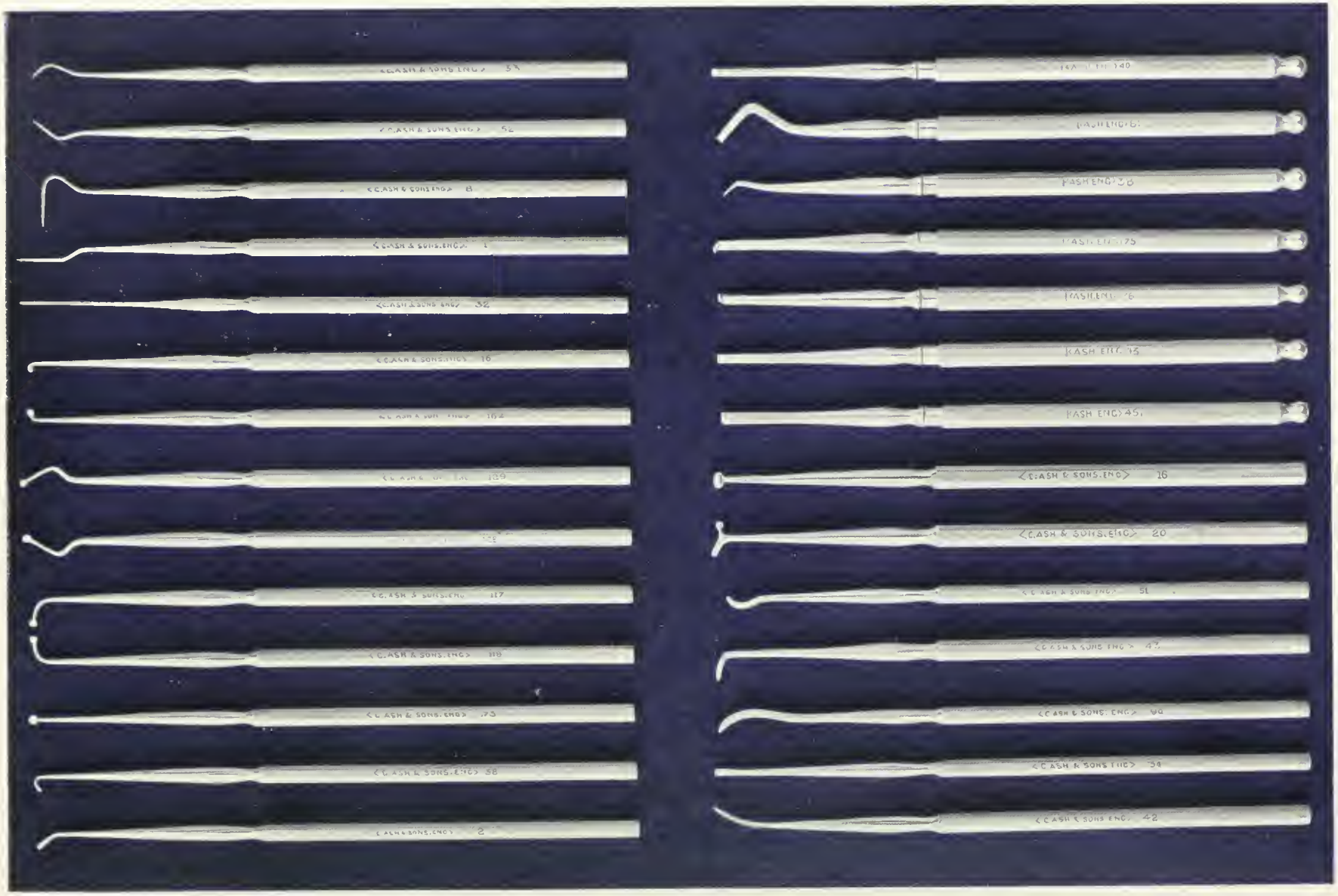


OPERATING INSTRUMENTS.

From the delicately fashioned and beautifully finished instruments which are available to the dentist of to-day for operative purposes, it is a far cry back to their crude forerunners of the dawn-time of dental art. Two thousand years, perhaps, would represent the gulf of time intervening between the not too prepossessing dental and surgical instruments depicted on a marble in the Lateran Museum at Rome and the latest types that enter into the equipment of the modern dental practitioner. The general progressive effort towards the attainment of the present high standard has, however, been made within the last hundred years.

Even as late as the eighteenth century, there was little of a noteworthy character to be observed in the distinctive design and construction of instruments used by dental surgeons; they had hardly anything to differentiate them from the small tools of the ordinary craftsman skilled in fine work, like that of the carver, the engraver, or the metal-worker. Such *finesse* as we now know was practically non-existent. The eminent Pierre Fauchard (1690-1761) worked with an outfit so exiguous that one marvels the more at what he accomplished. A few very simple files and some equally simple types of instruments for detaching tartar and scraping carious cavities, appear to have constituted his armoury. Referring to these, as illustrated in Fauchard's "Le Chirurgien Dentiste," Dr. Vincenzo Guerini (who has so industriously explored the literature of the past, and garnered a great store of ancient dental lore in his admirable "History of Dentistry," Part I., 1909) says: "One cannot but reflect on the inferiority of the instruments then in use, as compared with those of the present day. The greater admiration is therefore due to Fauchard's talent, which, in spite of such imperfect, and at times absolutely primitive, means, enabled him to obtain the brilliant results cited in his observations."

Those who, in ancient times, specialised to any extent in the dental branch of surgery must have felt the need of special apparatus, and doubtless enlisted mechanical skill as far as possible to meet the requirement. This, indeed, seems clear from the records left us by early writers. The Arabian surgeon Abulcasis (*circa* A.D. 1100) enlarges considerably upon dental instrumentation in his treatise "De Chirurgia," which Dr. Guerini considers to be the first work giving figures of dental instruments. It shows fourteen forms of dental scrapers, in a few of which there can be traced some resemblance to those now in use. There are also illustrations of dental elevators, saws, and a file of curious shape, besides various types of forceps. Numerous authors who wrote in the Middle Ages have something to say about dental instruments particularly Giovanni d'Arcoli (d. 1484), who, by the way, makes perhaps the earliest known reference to that


< C.ASH & SONS ENG > 53
< C.ASH & SONS ENG > 52
< C.ASH & SONS ENG > 8
< C.ASH & SONS. ENG > 1
< C.ASH & SONS ENG > 32
< C.ASH & SONS. ENG > 16
< C.ASH & SONS ENG > 164
< C.ASH & SONS. ENG > 139
< C. ASH & SONS. ENG > 117
< C.ASH & SONS. ENG > 118
< C. ASH & SONS. ENG > 73
< C. ASH & SONS. ENG > 58
< C.ASH & SONS ENG > 2
< C.ASH & SONS ENG > 140
< C.ASH ENG > 6
< C.ASH & SONS ENG > 38
< C.ASH & SONS. ENG > 75
< C.ASH & SONS ENG > 6
< C.ASH & SONS. ENG > 15
< C.ASH & SONS ENG > 45
< C.ASH & SONS. ENG > 16
< C.ASH & SONS. ENG > 20
< C. ASH & SONS ENG > 51
< C. ASH & SONS ENG > 42
< C. ASH & SONS. ENG > 60
< C. ASH & SONS ENG > 39
< C. ASH & SONS ENG > 42

rather fearsome old weapon the "Pelican" (*Forceps pro extrahendis dentibus pulicanum dicta*). We mention this, though the instrument is not properly within the scope of our present chapter.

That very distinguished French surgeon, Ambroise Paré (1517–1592) portrays in his works dental files, gum lancets, and a trifid lever. We begin to note here features somewhat more individualistic, and also a greater elaboration of design. The Spaniard, Francisco Martinez, published in 1557 a work on dentistry in which he illustrates, *inter alia*, a quite daintily formed excavator for ascertaining which among several decayed teeth was causing pain. It looks capable of deciding the question!

A notable seventeenth century work is the "Armamentarium Chirurgicum," by Johann Schultes. The instruments therein described include nine specially adapted to dental purposes. Of these, several attract attention by the carving on their handles. Exigencies of space compel us to leave the company of the old writers with just a passing reference to the advice of Pierre Dionis (d. 1718) to practitioners who are summoned to attend to the teeth of persons of rank. He recommends in such cases the use of gold instruments—a "sign of the times" truly, indicating how hard and fast was the line then drawn between Demos and the patrician.

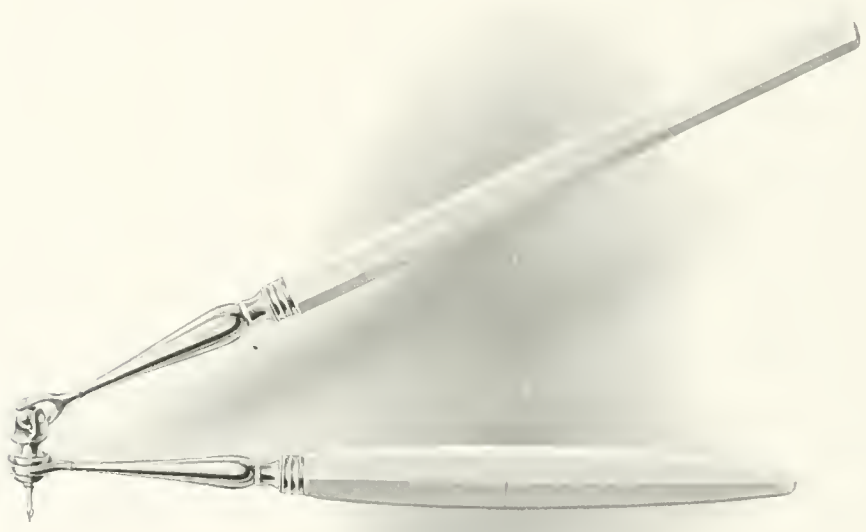
We have no more than touched the fringe of a subject of much interest to the student of dental history, and there still remains to note how, during the hundred years of our immediate retrospect, the development of dental instruments has progressed *pari passu* with that of other branches of dental art. The multiplication of types and forms led at length to no little confusion in the matter of classification; but since the middle of last century there has been evolved the system of nomenclature which individualises the instruments upon the plan described by Dr. G. V. Black in his "Operative Dentistry" (Vol. II.), with its Order Names, Sub-Order Names, Class Names, and Sub-Class Names. That such a scheme should have become necessary, proves how wide is the scope of this department of dental supply to-day, in comparison with its limited ambit in bygone times.

As in everything else that is of moment in applied science, the quality of the instruments used in operative dentistry is a consideration of prime importance. Time was when there was loud and general complaint as to the inferiority of the steel of which such instruments were made. The policy pursued by the leading makers of our own time has removed all dissatisfaction from that cause and demonstrated that in high-grade material the practitioner has an asset of real value. The typical operating instruments of the present time are as far ahead of those of the past in their intrinsic quality as they are in elegance of design, precision of adjustment, and exact adaptation to purpose.

(ASH.ENG) 55
(ASH ENG) 54
(ASH.ENG) 34
(ASH ENG) 35
(ASH ENG) 21
(ASH.ENG) 20
(ASH ENG) 19
(ASH ENG) 18
(ASH ENG) 1

DENTAL ENGINES AND ENGINE INSTRUMENTS.

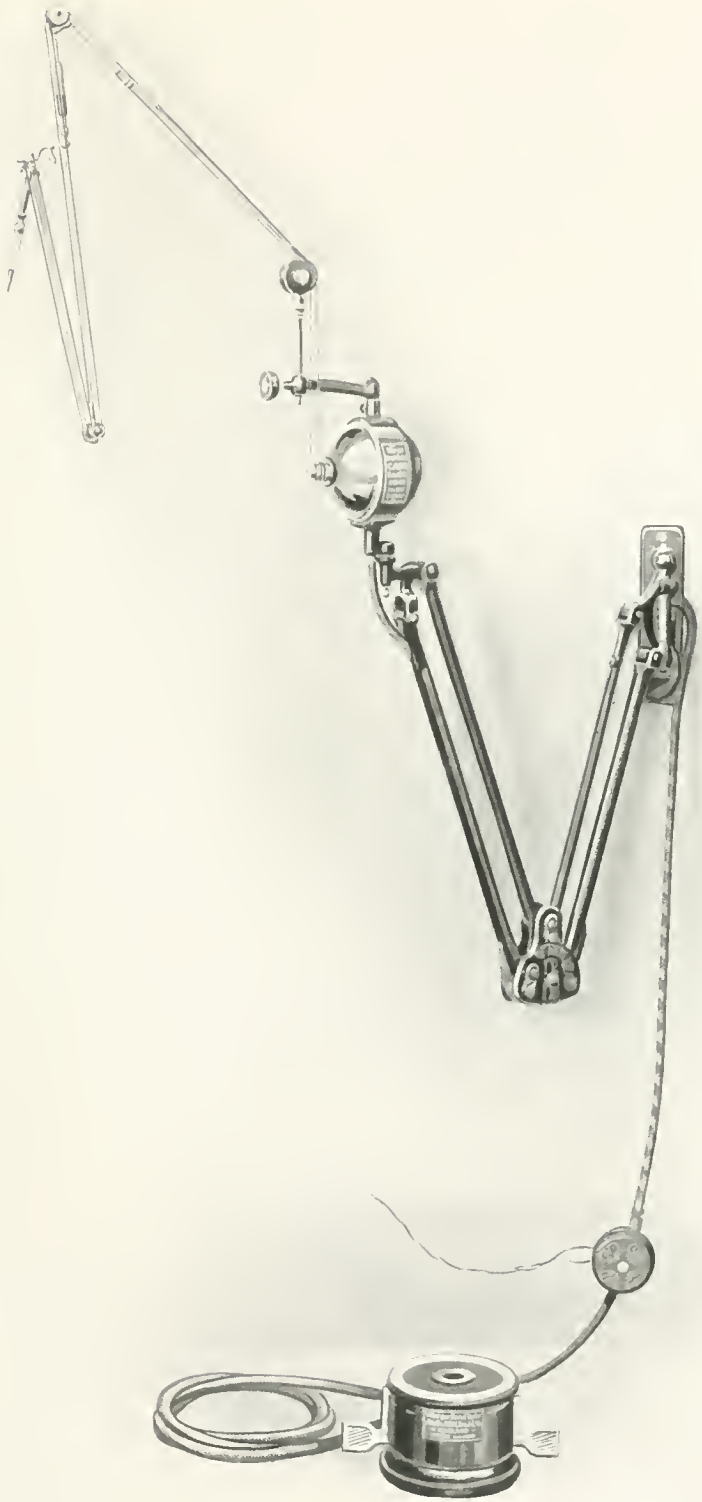
When we come to consider the subject of dental engines, we are reminded that most of the practical triumphs of civilisation have been consummated by the inter-working of art with art. It is through such co-operation of technical agencies, in giving effect to the conceptions of creative minds, that the great devices which lessen labour, increase production, annihilate distance, or quicken



communication have "materialised." With the assistance of the mechanical art, the dental art rises to-day upon its highest flights.

The term "dental engine" may sound a little ponderous, but it is quite proper to the idea it expresses. An engine is a machine. Engineering embraces all applications of mechanics to purposes of utility, and the dental profession has had to invoke its aid. Under the extreme pressure of modern practice, the dentist has need of whatever may accelerate his work and economise his time.

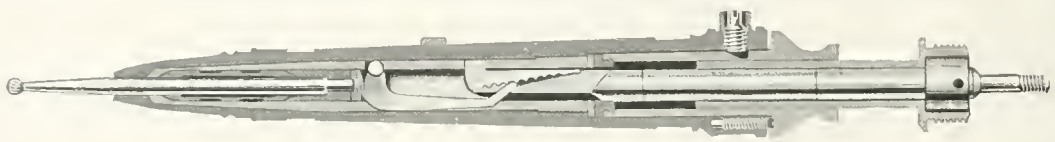
It has taken many a year to evolve the dental engine as we know it to-day. In the beginning, a crude hand-drill and bur, supplemented by the enamel chisel



and excavator, were all that the dental operator possessed for the removal of carious material from the cavity of a tooth. There followed a more elaborate Archimedean drill, limited, however, in scope of operation; being straight and rigid, it could be employed only in straightforward and easily accessible cavities.

With the advent (probably about eighty years ago) of the ingenious little instrument illustrated on page 54, a step forward was taken. Owing to its cleverly devised swivel arrangement, the dentist could reach and operate in cavities awkwardly situated.

Down to the 'seventies, most practitioners continued to employ hand instruments for the preparation of cavities for filling with gold or amalgam. By that time the old order began gradually to give place to the new. Towards the close of the 'sixties (Black tells us) a small pneumatic engine was attached to a sleeved mandrel, carrying a bur or drill, which was worked by an air-pump with a rubber tube. About 1871 the Morrison engine was



in evidence, and Ash's 1875 catalogue particularised the Parson Shaw engine; this was introduced by C. Ash & Sons, and exhibited some striking improvements, including the flexible universal joint, which enabled the operator to get at difficult cavities and work with greater ease.

Within a decade after 1870 many different types of dental engines made their appearance. A few favourite forms secured and retained the highest places in professional estimation, and came rapidly into general use. Further development has carried this important phase of dental mechanics to the point of perfection represented by the engine illustrated on page 55, and the handpiece illustrated above—the earliest known ancestor of which, as far as we can trace (but *longo interrallo*), was the handpiece designed by Linderer in the early part of the nineteenth century.

On the opposite page we illustrate a representative selection of the dental engine's armoury of accessories in exemplification of the efficiency of modern dental art.

BURS.

Dentistry, in a physical sense, is the realm of small things; most of its requisites are, for obvious reasons, of inconspicuous bulk. But importance is not necessarily measured by magnitude. Tennyson's line, "The little great, the infinite small thing," is being continually justified in the daily round of dental practice. There is, for example, the bur—materially an atom, mechanically a power.

The primary aim of the practitioner is to arrest disintegration of the natural teeth, and, where possible, to prolong their usefulness. In this branch of his work, his first and chief resource is the tiny bur, for which the introduction of the engine into dental surgery opened out a field of duty, wider perhaps than that of any other modern instrument designed to remedy or alleviate the ills that flesh is heir to.

Patients who, in time past, suffered acutely under the operation of the drill, could well be excused if their sentiments towards the bur were somewhat unfriendly. The fact is, that dentists were too long indifferent as to the quality of the burs they used; yet for them also there was an excuse. Manufacturers of burs paid less than due attention to the finer details of production. They maintained rather a dead level of mediocrity; and practitioners, conceiving that this represented the limit of advancement, had no opportunity of appreciating the advantages of the perfect bur.

The manufacture of burs is a highly specialised industry. It demands technical knowledge of an uncommon order, expert operative skill, and costly machinery. When a manufacturer had installed an expensive plant, he would be reluctant to "scrap" that plant ere he had reaped the fruits of his outlay. Thus, bur-making may be said to have got into a groove—a situation incompatible with real progress.

Three things, manifestly, go to constitute the perfect bur—design, material, execution. They are the basic principles of any mechanical work, but it is upon the manner of their application that everything depends. The design of the bur should be mechanically perfect, securing the utmost efficiency in operation, and eliminating that vibration which is a sure source of pain to the patient. The material must be steel of the highest quality, and of a chemical purity which guards against any deleterious effects. The execution can be confided only to craftsmen of exceptional skill and experience, for every bur requires the most careful individual treatment.

The essential qualifications thus briefly indicated are those which it has been sought to realise, and which, in fact, have been realised, in Ash Burs. The metallurgical, mechanical, and manipulative aspects of the industry have been intently studied by Ash's, who have also been bold enough to get rid of their old machinery, and to lay down a new plant for which it may be claimed that it is at this moment the "last word" in precision and capacity.

Interior View of one of the Workshops at Ash's Bur Factory.

CASTINGS.

Any survey of the advance of modern dentistry, however cursory, must bring the subject of casting within its purview; and ours may appropriately come to a conclusion with some reference to the progressive use of this process, which has,

in quite recent time, undergone a remarkable development. Casting has very greatly facilitated the labours of the dentist, alike in the preventive and in the prosthetic departments of his art, and when one compares its advantages with the laborious procedure of striking-up which was in vogue in the early days of dentistry, it is hard to realise that, even to this day, men can still be found who persist in their adherence to such a primitive method.

A great many years have passed since dentists first began to have recourse to casting, but in the early days of their efforts to produce metal dentures they lacked the appliances which later became available for fusing the precious metals, and for this reason they had to content themselves with what they could accomplish by the use of such low-fusing metals as tin and its alloys. Tin dentures were therefore among the earliest in which the casting method was exemplified. They were weak in resistance, and easily put out of shape; and the endeavour to strengthen the tin castings by the addition of proportions of other metals did not greatly improve the results.

Dr. M. O. Solbrig, in a valuable report on "Cast Metals in Dental Art," presented to the Dental Congress at Lille in 1909, and published in *Le Laboratoire*, traces the general evolution of dental casting from the middle of the nineteenth century. It was Dr. A. Blandy, of London, who patented, in 1856, an alloy of silver, bismuth, and a little antimony, which he called "cheoplastic metal." At this period, vulcanite being altogether unknown, the cheoplastic method appeared destined to take a prominent place in dental practice; but the unexpected introduction of vulcanized rubber caused the cheoplastic method to be almost completely abandoned. A few years later, the advocates of cast metal dentures renewed their attempts, and now sought success more particularly through the medium of aluminium, in which connection Dr. James B. Bean, of Baltimore, is credited with pioneer work. He had in the beginning to struggle against very great difficulties. For instance, when he first poured the molten aluminium directly upon the teeth or sectional pieces, they invariably cracked. Moreover, the aluminium exhibited very considerable contraction, and its lightness made the pouring into the mould difficult and slow.

Eventually, a skilful and ingenious mind partially overcame these difficulties, and paved the way for the researches of Dr. C. C. Carroll, who constructed an apparatus with which he obtained some fine dentures by casting the aluminium under pneumatic pressure. The slowness of the pouring into the mould still proved an obstruction in the making of cast aluminium plates, and though other workers tried to conquer this defect, the outcome generally was not very satisfactory. In order to achieve work at once more rapid and less subject to accidents, M. Pillette adapted to Dr. Bean's methods several modifications, the chief of which were: the coating of the original model with wax, and the forming of the mould by the "wax dispersion" method in lieu of casting into a mould composed of several parts. This method consists in the making of a wax model of the article to be cast, embedding it in an investment material, the subsequent

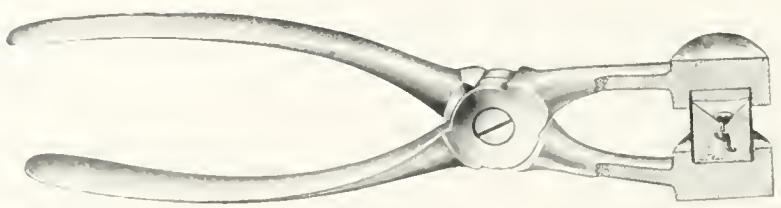
dispersion of the wax by means of heat, and the casting of molten metal into the mould thus formed.

As a point of interest, it may be recorded that the "wax dispersion" method of obtaining a mould is really of great antiquity, for according to Pliny, a Greek, Hysistratus of Secyone, during the reign of Alexander, modelled statuettes in wax, encased them in clay, burnt out the wax, and poured bronze into the mould.

The "wax dispersion" method was further improved upon by Dr. Ollendorf, late in the year 1905, who attained some measure of success in the making of gold dentures, but its full value was only recognised in dental work when Dr. Solbrig applied it to the making of gold inlays, and made it possible to obtain an inlay which not only exactly fitted the cavity without projecting beyond the edges, but required no retouching even for articulation.

The inventive mind, being further stimulated by the successes attending the efforts already described, then gave us the electric furnace designed by M. Platschick, of Paris, an appliance which rendered the processes of melting and casting almost automatic.

The next noteworthy stage of development was marked by the introduction of pressure casting, first by Dr. Taggart, who used compressed nitrous oxide gas, then by Dr. Solbrig, who used steam pressure. Dr. Solbrig designed a pair of pliers with cylindrically shaped jaws, the lower jaw hollowed out to form a shallow cup for receiving the investment ring, the upper similarly hollowed out for the reception of moist asbestos discs.



The mould having been prepared, and the gold fused by means of a blowpipe, the plier handles are closed, and the steam which is then generated from the moist asbestos pad forces the molten metal into the mould.

Pressure casting by the production of steam in the manner described is a remarkable instance of the simplicity of genius; further, it supplies us with an instance of two independent brains arriving simultaneously at the same conclusion, for, on the day on which Dr. Solbrig was ready to demonstrate his

casting pliers before the Société d'Odontologie of Paris in 1907, M. Platschick showed him that he had done the same thing on a larger scale.

The result was the Solbrig-Platschick Press for casting not only inlays, but even the largest plates and bridges.

The Solbrig-Platschick Patented Press.

We will not enter into the technique of this admirable work, which does away with the old method of sand moulding, casting of dies and counter-dies and hand swaging, but will only point out that there are no limitations to the

form of plates which can be produced by it; such a plate, for instance, as we here illustrate would be almost impossible, or at any rate extremely difficult, to strike up without splitting, yet its production by means of the Press presents no difficulty.

Equally, it is possible to employ platinized gold—a gold which offers considerable resistance, and is difficult to strike up.

A more truly fitting plate can be obtained by this method than by any

Three aspects of a gold plate cast in the Solbrig-Platschick Press.
Note the abnormally high palate.

other; moreover, the cast plate will not warp during subsequent heating—such as annealing, soldering on bands or backings—because, unlike a struck plate, the metal has been subjected to uniform pressure.

Nor do the capabilities of this method end with dentistry, for it has a wide range of application in the realm of artistic craftsmanship, as will be seen from the illustrations on the opposite page of trinkets cast in the Solbrig-Platschick Press, which well-nigh rival in delicacy the finest *orfèvrerie* wrought by hand.

HARBIN ‡
TIENTSIN ‡
SINGAPORE ‡
CALCUTTA ‡
‡ SANTIAGO
‡ SAMARANG
SYDNEY *
‡ AUCKLAND
‡ MELBOURNE
‡ WELLINGTON

Branches, Factories, and Agencies of

CLAUDIUS ASH, SONS AND CO., Limited.

* Indicates Branch.
† „ Factory.
‡ „ Agency.

UNIVERSITY OF CALIFORNIA LIBRARY
Los Angeles
This book is DUE on the last date stamped below.

MAY 0 1962
APR 2 1 REC'D
NOV 2 0 1963
Biomed Lib. BIOMED LIB
FEB 10 1972
JAN 27
Biomed BIOMED LIB.
DEC 15 1980
JAN 6 REC'D
BIOMED JUL 12 '84
JUN 28 REC'D
BIOMED MAR 29 '86
MAR 29 1986
REC'D

Form L9-52m-7,'61(C1437s4)444

D 000 132 650 3

3 1158 00608 9931